

LEVEL *IV*

12

AD A108946

5 *4* OHIO RIVER BASIN
MUDDY FORK, ELK COUNTY

6 PENNSYLVANIA

2 BUZZARD SWAMP WATERFOWL AREA

3 NO. 6 DAM

NDI I.D. PA-1007

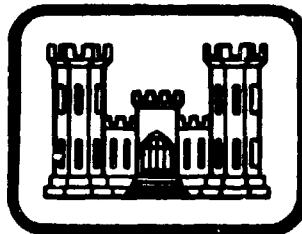
DER I.D. 24-51

7 OWNER: PENNSYLVANIA GAME COMMISSION

8 PHASE I INSPECTION REPORT

1 NATIONAL DAM INSPECTION PROGRAM

7 ACW 31-81-C-0014



PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
BALTIMORE, MARYLAND 21203

BY

D'APPOLONIA CONSULTING ENGINEERS
10 DUFF ROAD
PITTSBURGH, PA. 15235
AUGUST 1981

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of a dam is based upon visual observations and review of available data. Detailed investigations and analyses involving topographic mapping, subsurface investigations, material testing, and detailed computational evaluations are beyond the scope of a Phase I investigation. However, the Phase I inspection is intended to identify any need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The assessment of the conditions and the recommendations were made by the consulting engineer in accordance with generally and currently accepted engineering principles and practices.

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Buzzard Swamp Waterfowl Area No. 6 Dam
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Elk
STREAM: Muddy Fork, a tributary of the East Branch of Millstone Creek
SIZE CLASSIFICATION: Intermediate
HAZARD CLASSIFICATION: Significant
OWNER: Pennsylvania Game Commission
DATE OF INSPECTION: July 17, 1981 and July 31, 1981

ASSESSMENT: Based on the visual inspection and the evaluation of available information, the Buzzard Swamp Waterfowl Area No. 6 Dam is considered to be in good condition. At the time of inspection, no conditions were observed that would adversely affect the overall performance of the structure.

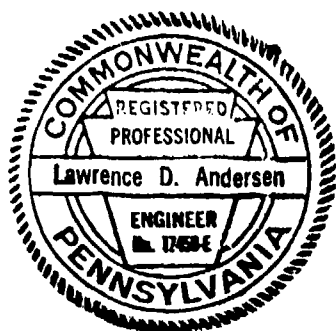
According to the recommended criteria, small dams in the significant hazard category are required to pass between the 100-year flood and 50 percent of the Probable Maximum Flood (PMF). The analysis showed that the spillway was capable of accommodating the upper limit of the spillway design flood, 50 percent of the PMF. Therefore, the spillway capacity is considered to be adequate.

The following actions are recommended for implementation as soon as possible or on a continuing basis;

1. Around-the-clock surveillance should be provided during unusually heavy rainfall and/or runoff. In addition, a formal warning system should be devised to provide for alerting downstream residents in the event of an emergency;
2. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed on a regular basis.

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Assessment - Buzzard Swamp Waterfowl Area No. 6 Dam



Lawrence D. Andersen

Lawrence D. Andersen, P.E.
Vice President

August 26, 1981

Date

Approved by:

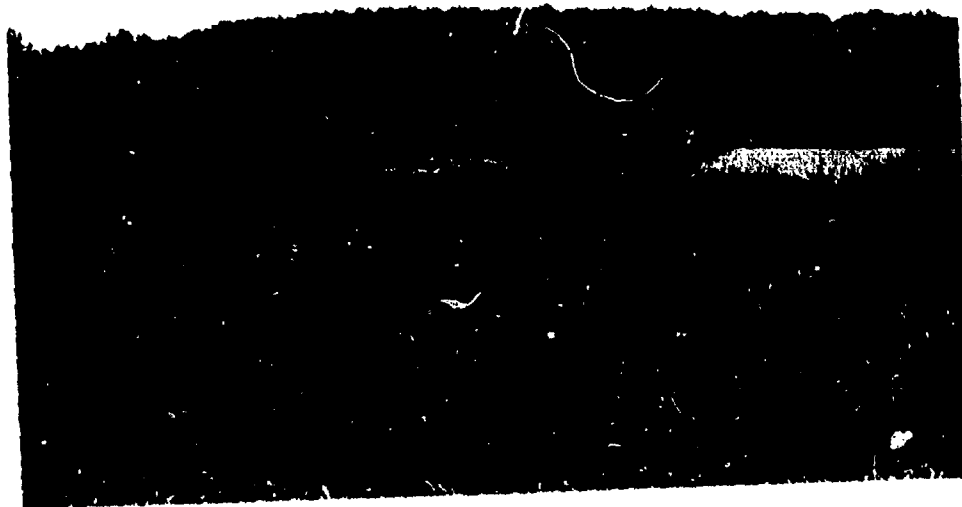
James W. Peck

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

18 Sep 1981

Date

BUZZARD SWAMP WATERFOWL AREA '10' 4
NDI I.D. PA-1002
DER I.D. 024-051
JULY 17, 1981



Upstream Face



Downstream Face

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
BUZZARD SWAMP WATERFOWL AREA NO. 6 DAM
NDI I.D. PA-1007
DER I.D. 024-051

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by the National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose. The purpose of this inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project

a. Dam and Appurtenances. The Buzzard Swamp Waterfowl Area No. 6 Dam consists of an earth embankment approximately 700 feet long, with a crest width of about 10 feet, and a maximum height of approximately 29 feet relative to its downstream toe. The upstream and downstream embankment faces are covered with grass and are constructed on slopes of 3 horizontal to 1 vertical and 2 horizontal to 1 vertical, respectively.

The flood discharge facilities at the dam consist of a weir type primary spillway equipped with stop-logs located near the midpoint of the dam and a grass-lined, trapezoidal open-channel emergency spillway on the left abutment (looking downstream). The available design drawings indicate that the low level outlet is an 18-inch-diameter ductile iron pipe which extends through the embankment along the original stream bed and terminates at the downstream toe of the dam. Flow through the pipe is controlled by a valve whose stem extends to the upstream slope of the dam. The lake can be drawn down partially by removing the spillway stop-logs and the remaining volume can be drained through the low level outlet facility.

b. Location. Buzzard Swamp Waterfowl Area No. 6 Dam is located on Muddy Fork approximately 1.5 miles upstream from its confluence with the East Branch of Millstone Creek in Millstone Township, Elk County, Pennsylvania (N41° 26.5', W79° 03.5'). Plate 1 illustrates the location of the dam.

c. Size Classification. Intermediate (based on 29-foot height, and approximately 1,164 acre-feet maximum storage capacity).

d. Hazard Classification. The dam is classified as a significant hazard. Downstream from the dam, Muddy Fork, the East Branch of Millstone Creek, and Millstone Creek flow through an uninhabited valley for approximately nine miles prior to joining the Clarion River. One vacation cabin located about 1.5 miles downstream from the dam (near the confluence of Muddy Fork with the East Branch of Millstone Creek) and the Loleta Recreational Area located approximately 5.5 miles downstream from the dam along the East Branch of Millstone Creek constitute the main areas of impact for a flood resulting from the failure of the dam. It is estimated that a secondary highway located near the Loleta Recreational Area would also be damaged if dam failure occurred. It is estimated that failure of the dam might cause loss of a few lives and some property damage in these downstream areas.

e. Ownership. Mr. Glenn L. Bowers, Executive Director, Pennsylvania Game Commission, Box 1567, Harrisburg, Pennsylvania 17120.

f. Purpose of Dam. Waterfowl conservation.

g. Design and Construction History. The dam was designed in 1969 by L. Robert Kimball, Consulting Engineers, of Ebensburg, Pennsylvania. Wagner and Hartle, Inc. (R.D. No. 1, Shippensburg, Pennsylvania 16254) began dam construction in the summer of 1969 and completed the facility in August of 1971.

h. Normal Operating Procedure. The reservoir is normally regulated by the addition or removal of stop-logs at the primary spillway weir. According to the owner, the spillway or stop-log crest is set at about Elevation 1620 during the winter season and is lowered to approximately Elevation 1618 for the summer season. Thus, the available freeboard relative to the low spot on the dam crest is approximately seven feet during the winter and about nine feet during the summer. Normal excess reservoir inflows are discharged over the crest of the primary spillway stop-logs. Larger reservoir inflows are discharged through the 225-foot-wide emergency spillway.

1.3 Pertinent Data. Elevations referred to in this and subsequent sections of the report were calculated based on approximate field measurements, assuming the emergency spillway crest to be at Elevation 1623.0. Elevation 1623.0 is the average emergency spillway crest elevation shown on the available as-built drawings.

a. Drainage Area

2.7 square miles⁽¹⁾

⁽¹⁾ Planimetered from the USGS topographic map and shown in state files.

b. Discharge at Dam Site (cfs)

Maximum known flood at dam site	Unknown
Outlet conduit at maximum pool	Unknown
Gated spillway capacity at maximum pool	Not applicable
Primary spillway capacity at maximum pool	680 (with stop-logs in place - winter pool) 890 (without stop- logs - summer pool)
Total spillway capacity at maximum pool	5524 (with stop-logs in place - winter pool) 5795 (without stop- logs - summer pool)

c. Elevation (feet)

Top of dam	1627.0 (design) 1627.2 (measured low spot)
Maximum pool	1627.2
Normal pool	1620 ⁺ (winter) 1618 ⁺ (summer)
Upstream invert of outlet works	1600.0 (design)
Downstream invert of outlet works	1598 ⁺
Maximum tailwater	Unknown
Toe of dam	1598 ⁺

d. Reservoir Length (feet)

Normal pool level (at winter pool Elevation 1620)	4100 ⁺
Maximum pool level	4400 ⁺

e. Storage (acre-feet)

Normal pool level (at winter pool Elevation 1620)	293
Maximum pool level	1164

f. Reservoir Surface (acres)

Normal pool level (at winter pool Elevation 1620)	66
Maximum pool level	186 ⁺

g. Dam

Type	Earth embankment
Length	700 feet

Zoning
 Impervious core
 Cutoff
 Grout curtain

No
 No
 No
 No

h. Regulating Outlet

Type
 Length
 Closure
 Access
 Regulating facilities

18-inch-diameter
 ductile iron pipe
 150⁺ feet
 Upstream gate valve
 Dam crest
 Upstream gate valve
 with stem extending
 to upstream slope.

i. Spillway

Primary:

Emergency:

Type

Stop-log weir with
 concrete discharge
 channel

Grass-lined,
 trapezoidal-shaped
 open channel

Crest length

10 feet

215 feet (as measured)(2)

Crest elevation

1620⁺ (winter)
 1618⁺ (summer)

1623 ⁺ (as measured)

Upstream channel

Lake

Grass-lined channel

Downstream channel

10-foot-wide
 reinforced con-
 crete channel
 which transports
 discharge to a
 reinforced concrete
 energy dissipator
 (impact basin).

Grass-lined channel

(2) Design spillway width is 210.0 feet.

SECTION 2 DESIGN DATA

2.1 Design

a. Data Available. The available data consist of files provided by the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER), which contain design drawings, correspondence, construction progress and inspection reports, and inspection photographs. A report entitled "Engineering Report on Buzzard Waterfowl Area Impoundments No. 1, 4, 5 and 6," dated 1969, prepared by L. Robert Kimball Consulting Engineers, Ebensburg, Pennsylvania, includes engineering calculations and construction specifications.

(1) Hydrology and Hydraulics. The available information includes the design capacities of the spillways, the normal pool reservoir surface area, the reservoir drainage area, and the hydrologic design criteria.

(2) Embankment. The available information consists of various design and as-built drawings, design calculations, construction progress reports, and previous state inspection reports.

(3) Appurtenant Structures. The available information consists of design and as-built drawings, and design calculations.

b. Design Features

(1) Embankment. Plates 2 and 3 illustrate the plan of the reservoir and of the embankment, respectively. As shown on Plate 4, the dam is a homogeneous embankment designed to have a 3H:1V upstream slope, a 2H:1V downstream slope, and a 12-foot crest width.

(2) Appurtenant Structures. The appurtenant structures of the dam consist of primary and emergency spillways and a low level outlet as shown on Plates 3, 5, 6, and 7. The primary spillway consists of a concrete overflow structure equipped with stop-logs located near the midpoint of the dam and discharging into a ten-foot-wide reinforced concrete channel. The concrete channel directs flow to a reinforced concrete energy dissipator (impact basin) located at the toe level of the embankment. A concrete cutoff wall and concrete cutoff fins were provided for the primary spillway (at the centerline of the embankment alignment). The uncontrolled primary spillway crest is at Elevation 1615. Above this level, the overflow level can be adjusted by adding or removing stop-logs. According to the current operating procedure, normal pool is maintained at Elevation 1620 during winters and at Elevation 1618 during summers.

The emergency spillway was designed as a 210-foot-wide, grass-lined, trapezoidal open channel located on the left abutment. The design crest level was at Elevation 1624, about four feet above the winter normal pool level.

The low level outlet consists of an 18-inch-diameter ductile iron pipe with closure provided by an 18-inch-diameter gate valve near the upstream end of the pipe. Antiseep collars were provided along the length of the outlet pipe downstream from the valve.

c. Design Data

(1) Hydrology and Hydraulics. The 1969 engineer's report indicates that the emergency spillway was sized to meet the state's "C" curve criteria. The required capacity was reported to be 3200 cfs. Further, it was noted that sufficient storage was provided between the normal pool and the emergency spillway crest to store the runoff associated with a 100-year flood. At winter normal pool level, the capacity of the primary spillway is noted to be 240 cfs.

(2) Embankment. Plate 2 shows the plan of the reservoir. The embankment was designed as a homogenous fill with a 3H:1V upstream slope and a 2H:1V downstream slope. Plate 3 provides information as to the depth and extent of the cutoff trench in addition to listing the estimated site excavation and embankment fill quantities. Typical cross sections of the dam are included in Plate 4. The 1969 engineer's report indicates that a materials investigation and engineering analysis was conducted to size the embankment.

(3) Appurtenant Structures. Available information includes structural calculations for the primary spillway structure. The primary spillway sidewalls were designed as cantilevered retaining walls. Plates 5 through 7 include the details of the primary spillway structures. Typical cross sections of the emergency spillway are shown in Plate 8.

2.2 Construction. It is reported that the dam was constructed in accordance with the drawings and specifications under the supervision of the design engineer's field representative. The construction progress reports available in the files provide information relative to the compressive strengths of the actual concrete mixes used in constructing the appurtenant structures. No reports were found to indicate any major postconstruction changes to the dam structure.

2.3 Operation. There are no formal operating records maintained for the dam. The normal reservoir water level is regulated by the addition or removal of stop-logs to the primary spillway structure.

2.4 Other Investigations. None reported.

2.5 Evaluation

a. Availability. The available information was provided by PennDER.

b. Adequacy

(1) Hydrology and Hydraulics. The available information is not considered to be sufficient to assess the adequacy of the spillways.

(2) Embankment. Available information indicates that the design of the embankment includes materials investigation and engineering analysis. The design, in general, is considered to be in conformance with currently accepted engineering practices.

(3) Appurtenant Structures. Review of the design drawings indicate that the appurtenant structures are designed and constructed in conformance with currently accepted engineering practice.

SECTION 3 VISUAL INSPECTION

3.1 Findings

a. General. The onsite inspection of Buzzard Swamp Waterfowl Area No. 6 Dam consisted of:

1. The visual inspection of the embankment, abutments, and embankment toe.
2. The visual examination of the spillways and the visible portions of the outlet works.
3. The evaluation of the downstream area hazard potential.

The specific observations are illustrated on Plate 9.

b. Embankment. The general inspection of the embankment consisted of searching for indications of structural distress, such as cracks, subsidence, bulging, wet areas, seeps and boils, and observing the general maintenance conditions, vegetative cover, erosion, and other surficial features.

In general, the condition of the dam is considered to be good. The downstream embankment slope and crest areas are covered with grass and were found to be adequately maintained.

The dam crest was surveyed relative to the emergency spillway crest elevation and was found to be at or above the design level. The lowest embankment area occurred at a section near the right abutment. The dam crest profile, according to field measurements, is illustrated on Plate 10.

c. Appurtenant Structures. The appurtenant structures were examined for deterioration or other signs of distress and for obstructions that might limit their flow capacities. In general, the structures were found to be in good condition.

The owner reported that the low level outlet pipe valve is operated annually. However, operation of the valve was not observed.

d. Reservoir Area. A map review indicates that the watershed is predominantly covered by woodlands and swamp. No signs of landslide activity were found in the vicinity of the reservoir. A review of the regional geology is included in Appendix F.

e. Downstream Channel. Downstream from the dam, Muddy Fork flows approximately 1.5 miles through an uninhabited valley prior to joining the East Branch of Millstone Creek. A further description of the downstream conditions is included in Section 1.2 d.

3.2 Evaluation. The Buzzard Swamp Waterfowl Area No. 6 Dam was found to be in good condition and adequately maintained. The operational condition of the low level outlet pipe was not observed; however, the owner reports that the regulating valve is operated annually.

SECTION 4 OPERATIONAL FEATURES

4.1 Procedure. Although a formal operations manual is not available, the reservoir is reportedly maintained at about Elevation 1620 during the winter months and at about Elevation 1618 during the summer months. Normal reservoir levels are regulated by the addition or removal of stop-logs at the principal spillway structure. Normal reservoir inflows are discharged over the principal spillway with larger reservoir inflows discharged through the unregulated emergency spillway. Operation of the low level outlet valve is reportedly done annually to ensure operability.

4.2 Maintenance of the Dam. The maintenance of the dam is considered to be good. The crest and slopes of the dam are covered with grass and are adequately maintained.

4.3 Maintenance of Operating Facilities. Both the stop-logs and the visible portions of the low level outlet regulating system appear to be well maintained. However, the actual operational condition of the low level outlet valve was not observed.

4.4 Warning System. No formal warning system exists for the dam.

4.5 Evaluation. The overall maintenance condition of the dam is considered to be good. Operation of the low level outlet valve should continue on at least the reported annual basis to ensure operability.

SECTION 5 HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. The Buzzard Swamp Waterfowl Area No. 6 Dam drains a watershed area of 2.7 square miles and impounds a reservoir with a surface area of 66 acres at normal winter pool Elevation 1620. The flood discharge facilities for the dam consist of a 215-foot-wide, grass-lined, trapezoidal emergency spillway channel located on the left abutment and a primary spillway structure located near the midpoint of the dam. The primary spillway structure is comprised of a stop-log weir which discharges into a ten-foot-wide concrete channel. The combined spillway capacity was estimated to be 5130 cfs with stop-logs in place and 5370 cfs with the stop-logs removed, based on the available freeboard relative to the low spot on the dam. Design data indicates that the capacity of the primary spillway, with the reservoir at winter normal pool level, is 240 cfs.

b. Experience Data. As previously stated, the Buzzard Swamp Waterfowl Area No. 6 Dam is classified as an intermediate dam in the significant hazard category. According to the recommended criteria for evaluating spillway discharge capacities, such impoundments are required to pass a flood whose magnitude ranges between one-half and full PMF. In view of the height and storage capacity of this dam which correspond to the lower limits within the intermediate size classification, one-half PMF is considered to be the appropriate spillway design flood.

The PMF inflow hydrograph for the reservoir was determined utilizing the Dam Safety Version of the HEC-1 computer program developed by the Hydrologic Engineering Center of the U.S. Army Corps of Engineers. The data used for the computer analysis are presented in Appendix D. The one-half PMF inflow hydrograph was found to have a peak value of 2800 cfs. The computer input and a summary of the computer output are also included in Appendix D.

c. Visual Observations. On the date of inspection, no conditions were observed that would indicate that the spillway capacity would be significantly reduced during the passage of a large flood.

d. Overtopping Potential. The available spillway capacity was found to be greater than the design flood peak of one-half PMF. Further, various percentages of the PMF inflow hydrograph were routed through the reservoir to determine the maximum percent of the PMF inflow that the dam could pass without overtopping the embankment. The computer analysis indicated that the spillway can accommodate the full PMF without overtopping. The PMF inflow will result in a maximum water surface level of approximately Elevation 1627.1 within the reservoir, leaving approximately 0.1 foot of freeboard below the measured low spot of the dam.

e. Spillway Adequacy. The available spillway capacity was found to be in excess of the recommended spillway design capacity requirements. Therefore, the spillway is considered to be adequate.

SECTION 6 STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

(1) Embankment. As discussed in Section 3, field observations did not reveal any signs of distress that would adversely affect the performance of the structure at this time. In addition, no unsatisfactory conditions have been reported in the past.

(2) Appurtenant Structures. No conditions were observed that would adversely affect the structural performance of the appurtenant structures.

b. Design and Construction Data

(1) Embankment. The available design and construction information indicates that the dam was designed based on the evaluation of subsurface conditions, materials testing, and engineering analysis. The safety factor against sliding for the downstream slope is reported to be 2.8. It appears that the analysis is based on assumed soil strength values. Based on visual observations, the structural stability of the embankment is considered to be adequate.

(2) Appurtenant Structures. -A review of the design drawings indicates that there are no apparent structural deficiencies that would significantly affect the performance of the appurtenant structures.

c. Operating Records. Not maintained.

d. Postconstruction Changes. There have been no reported post-construction modifications to the original design.

e. Seismic Stability. The dam is located in Seismic Zone 1, and based on visual observations, the static stability of the dam is considered to be adequate. Therefore, based on the recommended criteria for the evaluation of seismic stability of dams, the structure is presumed to present no hazard as a result of earthquakes.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Assessment. Visual observations indicate that the condition of Buzzard Swamp Waterfowl Area No. 6 Dam is good. At the time of inspection, no conditions were observed that would adversely affect the overall performance of the structure.

According to the recommended criteria, small dams in the significant hazard category are required to pass between the 100-year flood to 50 percent of the PMF. The analysis showed that the spillway was capable of accommodating the upper limit of the spillway design flood, 50 percent of the PMF. Therefore, the spillway capacity is considered to be adequate.

b. Adequacy of Information. The available information, in conjunction with the visual observations, is considered to be sufficient to make a Phase I evaluation.

c. Urgency. The following actions are recommended for implementation as soon as possible, or on a continuing basis.

d. Necessity for Additional Investigations. No additional investigations are considered to be required at this time.

7.2 Recommendations/Remedial Measures. It is recommended that:

1. Around-the-clock surveillance should be provided during unusually heavy rainfall and/or runoff. In addition, a formal warning system should be devised to provide for alerting downstream residents in the event of an emergency.
2. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed on a regular basis.

APPENDIX A
CHECKLIST
VISUAL INSPECTION
PHASE I

APPENDIX A
CHECKLIST
VISUAL INSPECTION
PHASE I

Buzzard Swamp
NAME OF DAM Waterfowl Area No. 6 Dam
TYPE OF DAM Earth
DATE(S) INSPECTION July 17, 1981
COUNTY Elk
STATE Pennsylvania
HAZARD CATEGORY Significant
WEATHER Sunny
TEMPERATURE 80
POOL ELEVATION AT TIME OF INSPECTION 1618.7
TAILWATER AT TIME OF INSPECTION N/A
M.S.L. M.S.L.
NDI: PA-1007
ID# DER: 024-051

INSPECTION PERSONNEL:

Wah-Tak Chan, P.E.

Bilgin Erel, P.E.

REVIEW INSPECTION PERSONNEL:
(July 31, 1981)

Lawrence D. Andersen, P.E.

James H. Poellot, P.E.

Wah-Tak Chan, P.E.

Owner's Representative:

Mr. Donald Parr
Land Management Supervisor

Wah-Tak Chan, P.E. RECORDED

**VISUAL INSPECTION
PHASE I
EMBANKMENT**

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	See Plate 10 for dam crest profile.	
RIPRAP FAILURES	Some riprap protection on the upstream slope.	

**VISUAL INSPECTION
PHASE I
EMBANKMENT**

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No problems observed.	
ANY NOTICEABLE SEEPAGE	None observed.	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

**VISUAL INSPECTION
PHASE I
OUTLET WORKS**

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	No problems observed.	
INTAKE STRUCTURE	Submerged, not observed.	
OUTLET STRUCTURE	Outlet structure is partially submerged in plunge pool, no problems observed.	
OUTLET CHANNEL	Earth channel, no problems observed.	
EMERGENCY GATE	Owner reported that the gate valve for the 18-inch- diameter drainpipe is operated annually.	

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The emergency spillway consists of a 225-foot-wide grass-lined, trapezoidal-shaped open channel. It appears to be in satisfactory condition.	
APPROACH CHANNEL	Grass-lined open channel, no problems observed.	
DISCHARGE CHANNEL	Grass-lined open channel in good condition.	
BRIDGE AND PIERS	None	

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Primary spillway consists of a stop-log weir structure which discharges into a 10-foot-wide concrete channel. The spillway appears to be in satisfactory condition.	
APPROACH CHANNEL	Lake	
DISCHARGE CHANNEL	Concrete discharge channel transports flow to a reinforced concrete energy dissipator (impact basin) prior to discharging into a natural earth channel. Discharge channel and impact basin appear to be in good condition.	
BRIDGE PIERS	None	
GATES AND OPERATION EQUIPMENT	Wooden stop-logs can be added or removed manually from dam crest. System appears to be in operating condition.	

**VISUAL INSPECTION
PHASE I
INSTRUMENTATION**

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

VISUAL INSPECTION
PHASE I
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The area surrounding the lake is flat swampland. No problems observed.	
SEDIMENTATION	Unknown	
UPSTREAM RESERVOIRS	Several small ponds and lakes are located upstream from the dam in the swamp area. The three nearest lakes are formed behind earth embankments which range in height from 10 to 12 feet.	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No problems observed.	
SLOPES	No problems observed.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	One recreational campsite is located five miles downstream from the dam. Population varies with the season of the year.	

APPENDIX B
CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
AND HYDROLOGIC AND HYDRAULIC
- PHASE 1

APPENDIX B

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, OPERATION

PHASE I

Buzzard Swamp

NAME OF DAM Waterfowl Area No. 6 Dam

ID# NDI: PA-1007

DER: 024-051

ITEM	REMARKS
AS-BUILT DRAWINGS	See Plates 3, 5, 6, and 8.
REGIONAL VICINITY MAP	See Plate 1.
CONSTRUCTION HISTORY	Dam was designed by L. Robert Kimball, Consulting Engineers of Ebensburg, Pennsylvania in 1969. Wagner and Hartle, Inc. of Shippensburg, Pennsylvania started construction of the dam in 1969 and completed the facility in August 1971.
TYPICAL SECTIONS OF DAM	See Plates 4 and 8.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	See Plates 3, 6, and 7.

**CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I**

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None reported.
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Some hydrologic design criteria and the design spillway capacities are given in PennDER files in "Report Upon the Application of the Pennsylvania Game Commission," dated May 6, 1969.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Some materials testing results for upstream dam sites are available in PennDER files.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	None reported.
BORROW SOURCES	According to the owner's representative, the borrow sources for the embankment were the emergency spillway excavation area and an excavation area located to the north of the dam site.
MONITORING SYSTEMS	None
MODIFICATIONS	None
HIGH POOL RECORDS	None recorded.

**CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I**

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported.
MAINTENANCE OPERATION RECORDS	None recorded.
SPILLWAY PLAN SECTIONS DETAILS	See Plates 3, 5, and 6.
OPERATING EQUIPMENT PLANS AND DETAILS	See Plates 5 and 7.

CHECKLIST
ENGINEERING DATA
HYDROLOGIC AND HYDRAULIC

DRAINAGE AREA CHARACTERISTICS: 2.71 square miles, woodlands and swamplands
ELEVATION, TOP OF NORMAL POOL AND STORAGE CAPACITY: 1620 (winter pool, 293 acre-feet)
ELEVATION, TOP OF FLOOD CONTROL POOL AND STORAGE CAPACITY: 1623 (553 acre-feet)
ELEVATION, MAXIMUM DESIGN POOL: 1627
ELEVATION, TOP OF DAM: 1627.2 (measured low spot)

SPILLWAY: (Primary)

- a. Elevation Varies from 1615 to 1627; summer pool 1618±, winter pool 1620
- b. Type Stop-log weir structure which discharges into a concrete channel
- c. Width 10 feet (perpendicular to flow)
- d. Length 160± feet
- e. Location Spillover Midpoint of dam
- f. Number and Type of Gates 10-foot-wide wooden stop-logs, number varies with season of the year

SPILLWAY: (Emergency)

- a. Elevation 1623
- b. Type Grass-lined, trapezoidal-shaped open channel
- c. Width 215 feet (perpendicular to flow)
- d. Length 600± feet
- e. Location Spillover Left Abutment
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type 18-inch-diameter ductile iron pipe
- b. Location Near midpoint of the embankment, along the original stream
- c. Entrance Inverts 1600.0 (design) alignment
- d. Exit Inverts 1598
- e. Emergency Drawdown Facilities 18-inch-diameter gate valve with stem which extends to the embankment crest level. (Primary spillway can also be used for emergency drawdown to El. 1615.)

HYDROMETEOROLOGICAL GAGES:

- a. Type None
- b. Location N/A
- c. Records None recorded

MAXIMUM NONDAMAGING DISCHARGE: Calculated spillway capacity = 5524 cfs (stop-logs in place)
Note: Elevation Datum, USGS.

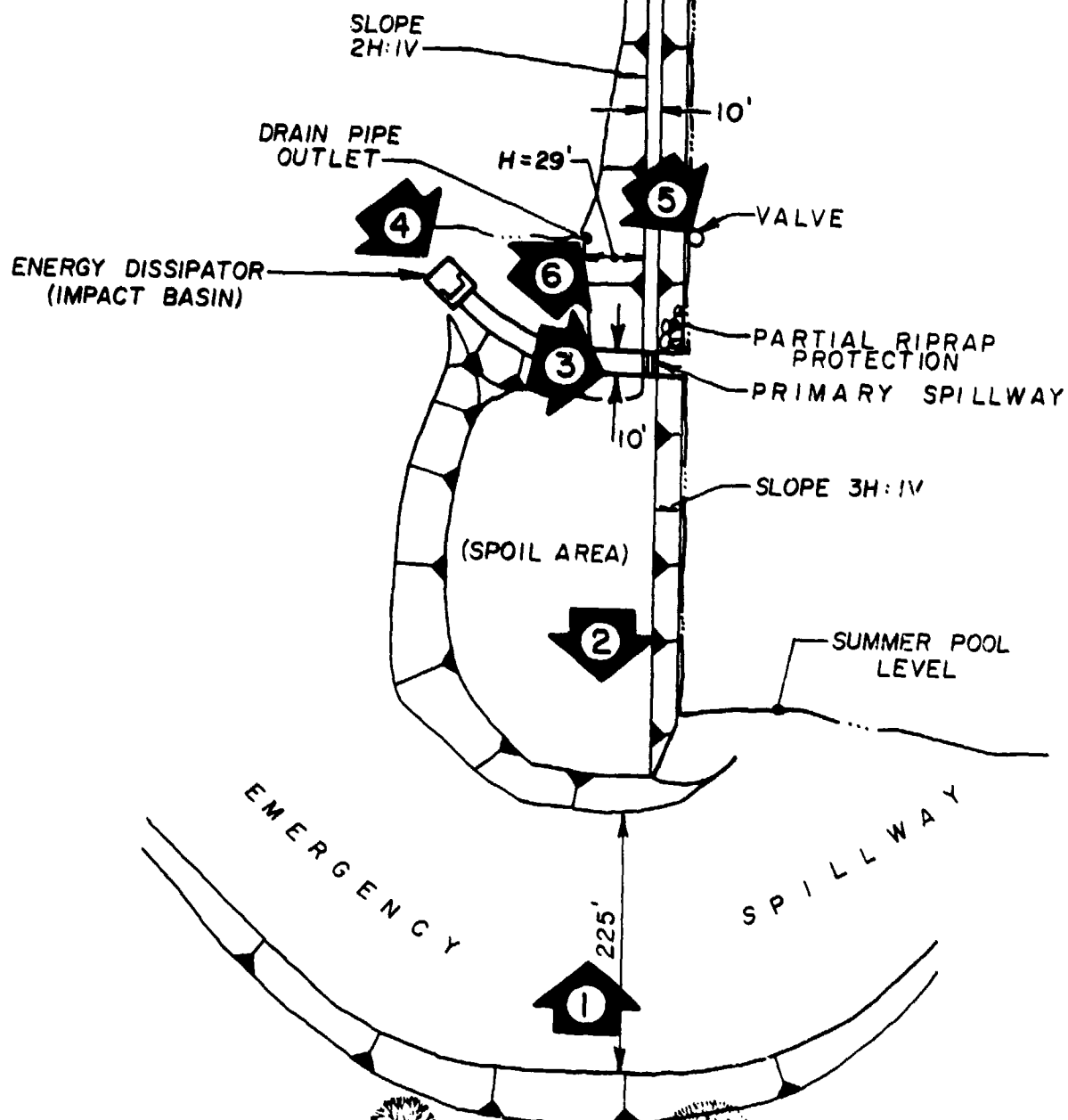
APPENDIX C
PHOTOGRAPHS

LIST OF PHOTOGRAPHS
BUZZARD SWAMP WATERFOWL AREA NO. 6 DAM
NDI I.D. NO. PA-1007
JULY 17, 1981

PHOTOGRAPH NO.

DESCRIPTION

- | | |
|---|---|
| 1 | Embankment and emergency spillway crests (looking south). |
| 2 | Emergency spillway crest (looking north). |
| 3 | Primary spillway and discharge channel (looking northwest). |
| 4 | Primary spillway energy dissipator (impact basin). |
| 5 | Drainpipe blowoff valve wheel located on the dam crest. |
| 6 | Drainpipe outlet. |
| 7 | Small recreational reservoir located five miles downstream. |
| 8 | Recreational campground located five miles downstream. |



LEGEND:



INDICATES DIRECTION
IN WHICH PHOTOGRAPH
WAS TAKEN

BUZZARD SWAMP WATERFOWL AREA
NO. 6 DAM
KEY PLAN OF PHOTOGRAPHS
FIELD INSPECTION DATE: JULY 17, 1981

IDA P P O L O N L A

"NOT TO SCALE"



PHOTOGRAPH NO. 2



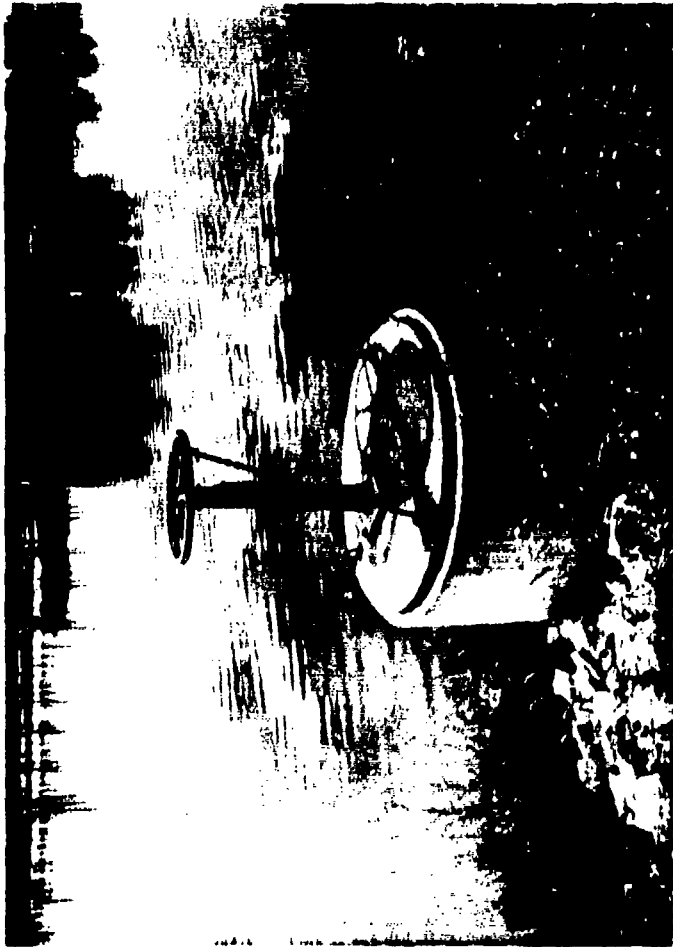
PHOTOGRAPH NO. 4



PHOTOGRAPH NO. 1



PHOTOGRAPH NO. 3



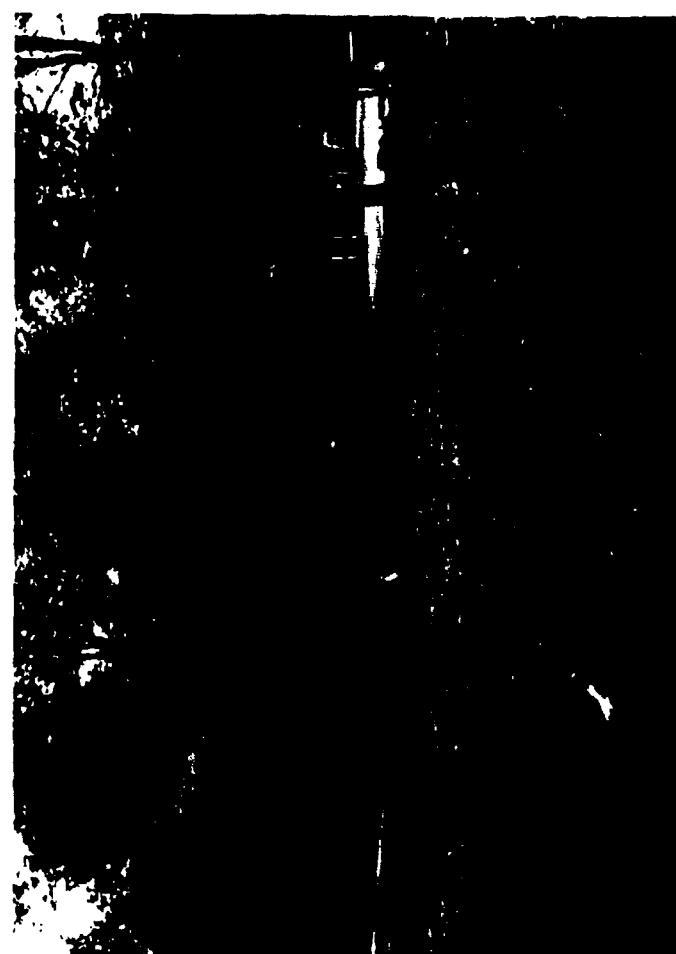
PHOTOGRAPH NO 5



PHOTOGRAPH NO. 6



PHOTOGRAPH NO.7



PHOTOGRAPH NO. 8

APPENDIX D
HYDROLOGY AND HYDRAULICS ANALYSES

HYDROLOGY AND HYDRAULIC ANALYSIS DATA BASE

NAME OF DAM: Buzzard Swamp No. 6 Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) = 23.2 INCHES/24 HOURS

STATION	1	2	3	4	5
Station Description	Lake	Dam			
Drainage Area (square miles)	2.71	-			
Cumulative Drainage Area (square miles)	2.71	2.71			
Adjustment of PMP for Drainage Area (X)(1)					
6 Hours	117	-			
12 Hours	126	-			
24 Hours	140	-			
48 Hours	151	-			
72 Hours	-	-			
Snyder Hydrograph Parameters					
Zone(2)	24	-			
C _p /C _t (3)	0.45/1.6	-			
L (miles)(4)	2.9	-			
L _{ca} (miles)(4)	1.0	-			
t _p = C _t (L·L _{ca}) ^{0.3} (hours)	2.20	-			
Spillway Data		Primary w/o stop-logs	Primary with stop-logs	Emergency	
Crest Length (ft)	-	10	10	215	
Freeboard (ft)	-	7.2	9.2	4.2	
Discharge Coefficient	-	3.2	3.2	2.65	
Exponent	-	1.5	1.5	1.5	

(1) Hydrometeorological Report 40, U.S. Weather Bureau, 1965.

(2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

(3) Snyder's Coefficients.

(4) L = Length of longest water course from outlet to basin divide.

L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

STORAGE VS. ELEVATION

ELEVATION	ΔH, FEET	AREA (acres)(1)	ΔVOLUME (acre-feet)(2)	STORAGE (acre-feet)
1605	5	1.1	19.3	0
1610		7.6		19.3
	5		67.9	
1615		20.6		87.2
	5		205.8	
1620 (normal pool)		56.0		293.0
1625	5	144.5	513.6	806.6
1630	5	234.7	938.9	1745.5

(1) Planimetered from USGS maps.

(2) ΔVolume = ΔH/3 (A₁ + A₂ + √A₁A₂).

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 01 APR 80

1	A1	SNYDER UNIT HYDROGRAPH, SPILLWAY AND DAM OVERTOPPING ANALYSES
2	A2	BUZZARD SWAMP NO.6 DAM, (DER 24-51), ELK COUNTY, PA. PROJECT NO.80-556-21
3	A3	FOR 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, AND 100% PROBABLE MAXIMUM FLOOD (PMF)
4	B	3CU 0 15 0 0 0 0 0 0 -4 0
5	B1	5
6	J	1
7	J1	0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
8	K	0 1
9	K1	CALCULATION OF SNYDER INFLOW HYDROGRAPH TO BUZZARD SWAMP AREA (DER 24-51)
10	M	1 2.71 2.71
11	P	23.2 117 126 140 151
12	T	1.0 0.05 0.0600
13	V	2.20 0.45
14	X	-1.5 -0.05 2.0
15	K	1 2
16	K1	ROUTING FLOW THROUGH BUZZARD SWAMP NO.6 DAM (DER 24-51) STOPLOG AT 1623
17	Y	1 1
18	V1	1
19	SA	1.1 7.6 20.6 66.0 144.5 234.7
20	SE1605.0	1610.0 1615.0 1620.0 1625.0 1630.0
21	SE1623.0	225.0 2.65 1.5
22	SD1627.2	2.65 1.5 600.0
23	SL 50.0	150.0 300.0 500.0 600.0
24	SV1627.2	1627.3 1627.5 1627.9 1628.1
25	K	99

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
				.20	.30	.40	.50	.60	.70	.80	.90	1.00
HYDROGRAPH AT	1	2.71 (7.02)	1	1121. (31.74)	1681. (47.61)	2242. (63.48)	2802. (79.35)	3362. (95.21)	3923. (111.08)	4483. (126.95)	5044. (142.82)	5604. (158.69)
	2	2.71 (7.02)	1	928. (26.28)	1425. (40.36)	1924. (54.49)	2425. (68.67)	2930. (82.96)	3435. (97.27)	3940. (111.57)	4445. (125.88)	4950. (140.17)

OVERTOPPING ANALYSIS SUMMARY

PAGE D3 OF 4

SUMMARY OF DAM SAFETY ANALYSIS

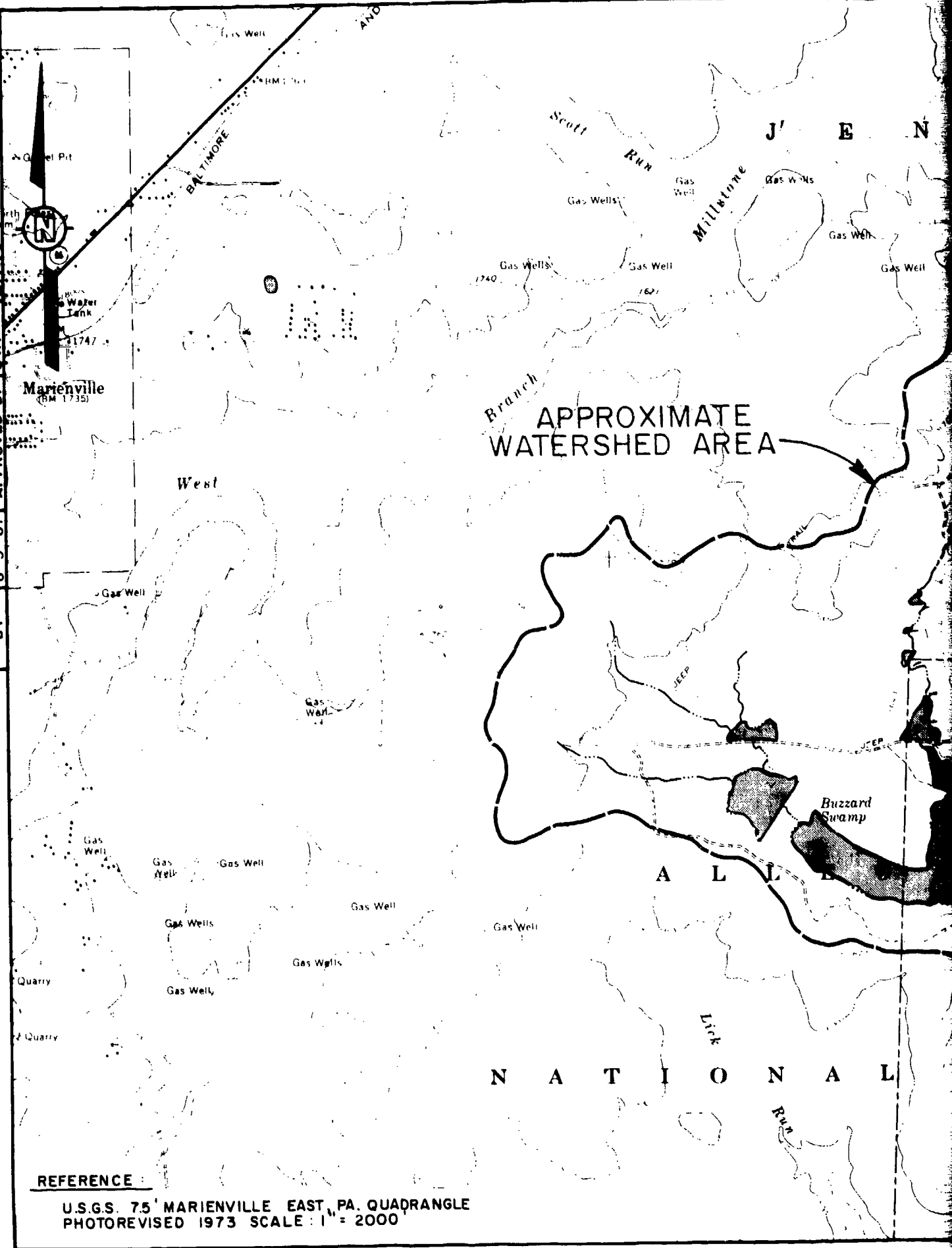
PLAN 1	ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM		TIME OF FAILURE HOURS
	STORAGE	OUTFLOW	1623.00	553.	1623.00	553.	1627.20	1164.	
			0.	0.	0.	0.	5132.		
RATIO OF PMF	MAXIMUM RESERVOIR U.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS			
.20	1624.34	0.00	716.	928.	0.00	43.50			0.00
.30	1624.79	0.00	776.	1425.	0.00	43.50			0.00
.40	1625.18	0.00	833.	1924.	0.00	43.50			0.00
.50	1625.55	0.00	888.	2425.	0.00	43.50			0.00
.60	1625.89	0.00	942.	2930.	0.00	43.25			0.00
.70	1626.21	0.00	994.	3435.	0.00	43.25			0.00
.80	1626.52	0.00	1045.	3940.	0.00	43.25			0.00
.90	1626.82	0.00	1096.	4445.	0.00	43.25			0.00
1.00	1627.10	0.00	1146.	4950.	0.00	43.25			0.00

FLOOD ROUTING ANALYSIS SUMMARY

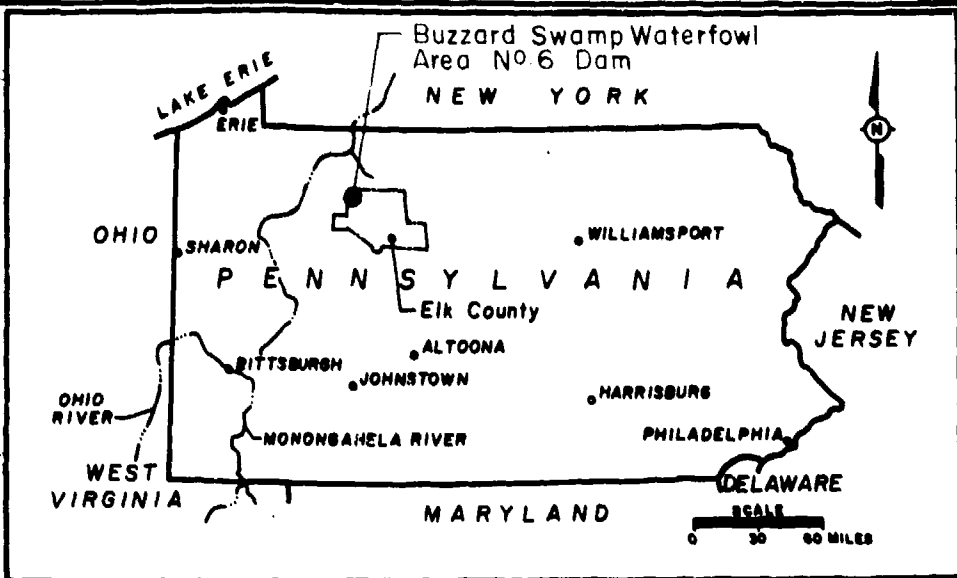
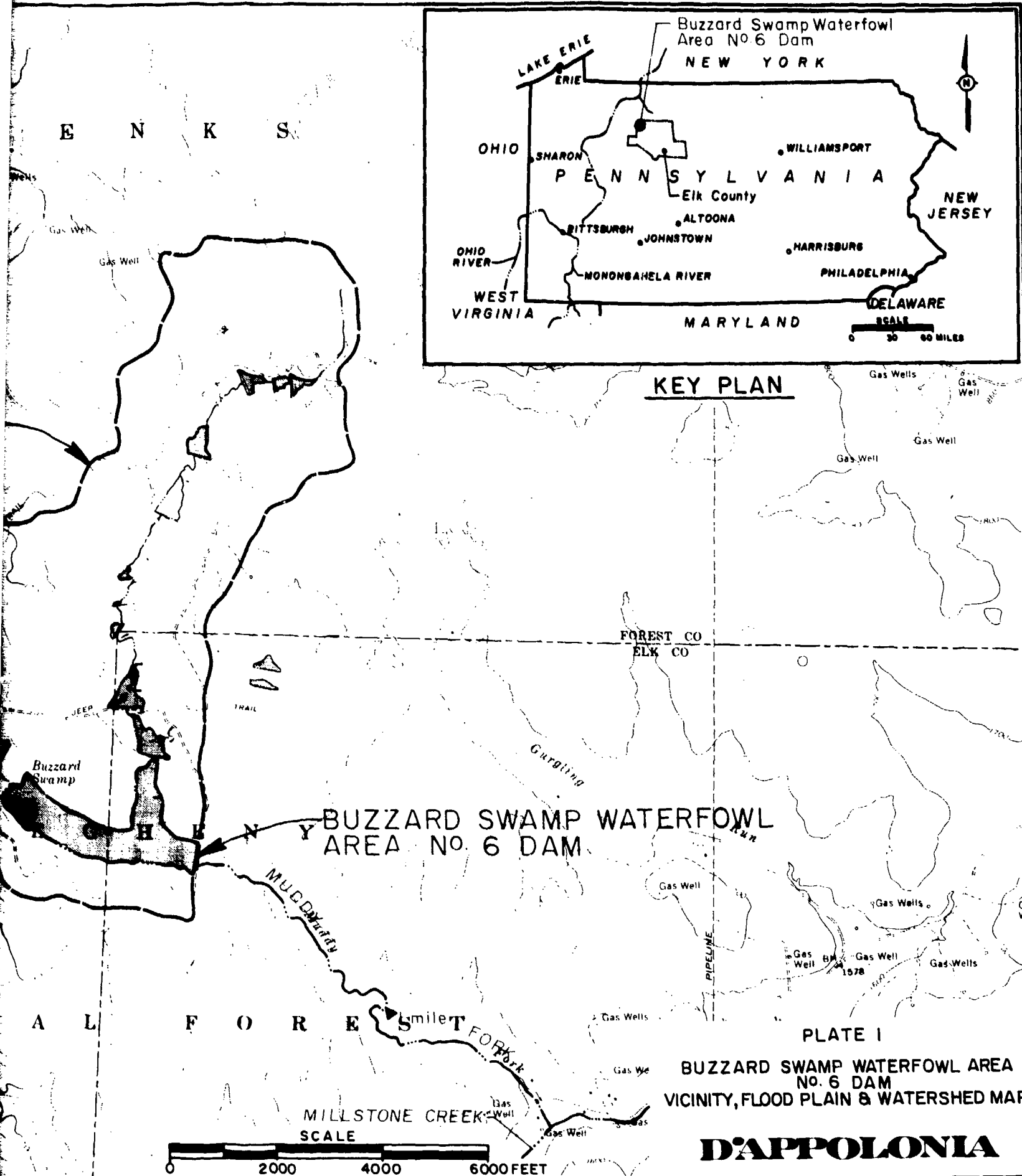
PAGE D4 OF 4

APPENDIX E
PLATES

DRAWN BY A Smith
 CHECKED BY 8-5-81
 APPROVED BY JAP
 DRAWING NUMBER 80-556-B50



REFERENCE:
 U.S.G.S. 7.5' MARIENVILLE EAST, PA. QUADRANGLE
 PHOTOREVISED 1973 SCALE: 1" = 2000'



KEY PLAN

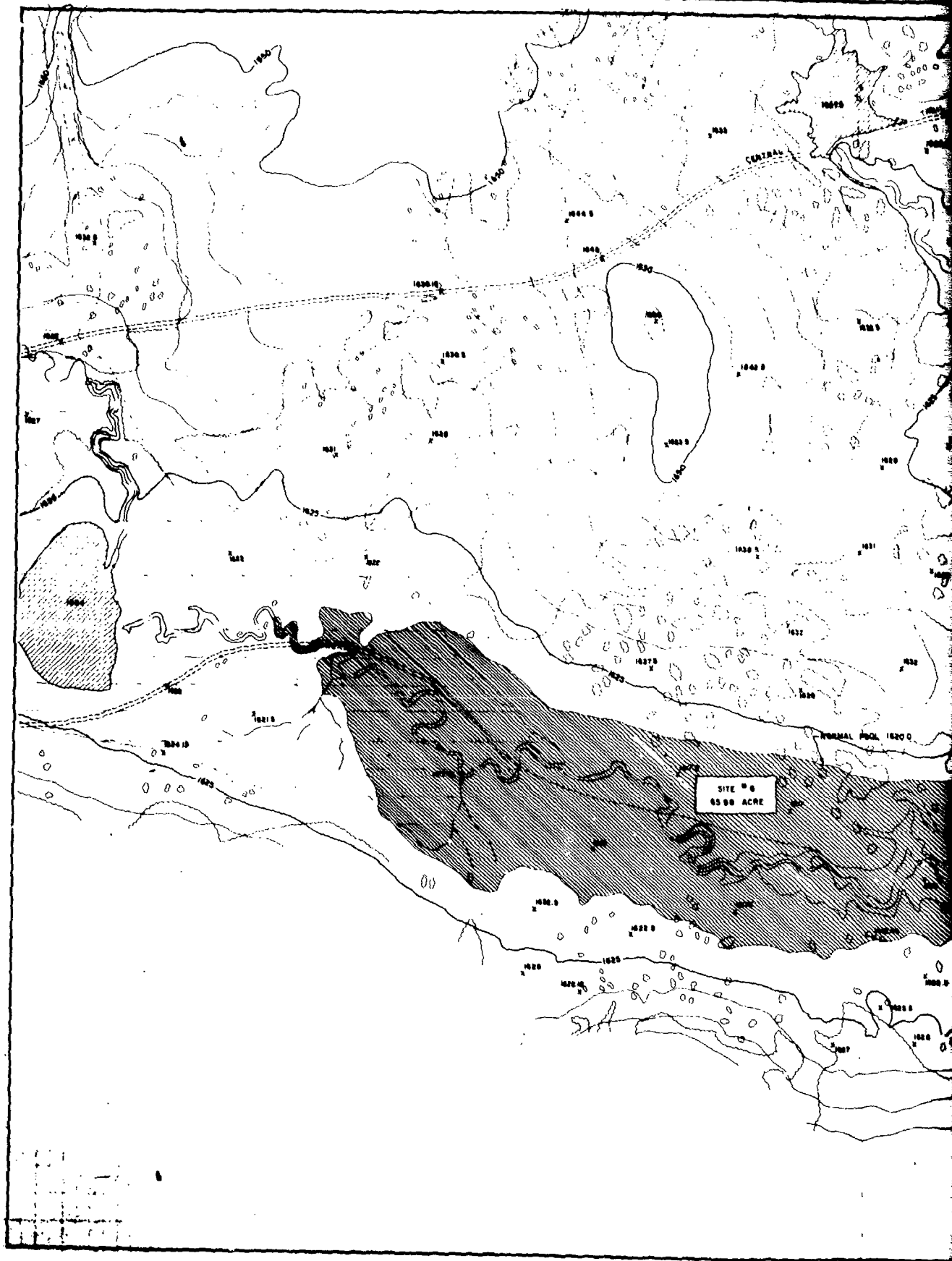
**BUZZARD SWAMP WATERFOWL
AREA NO. 6 DAM**

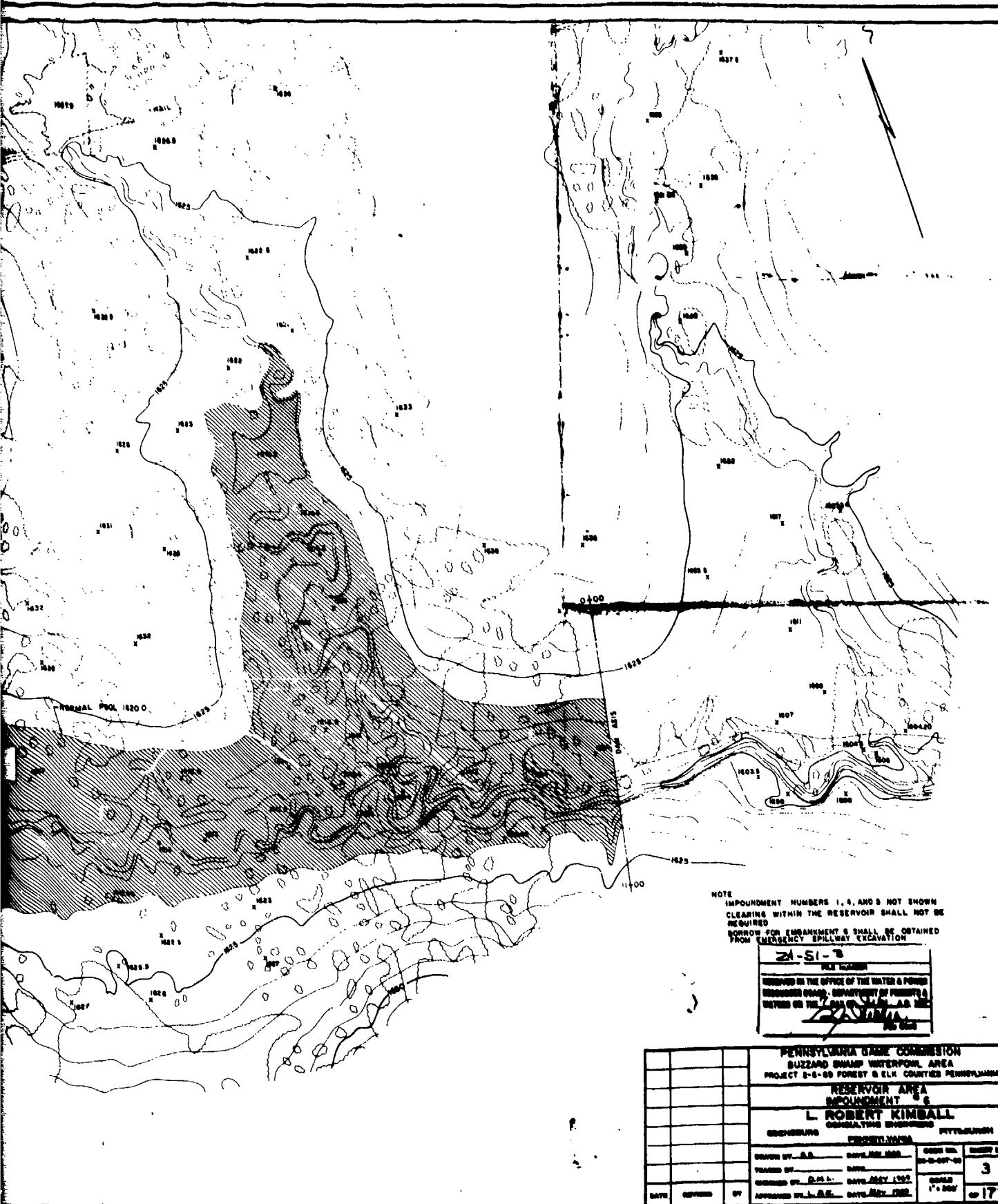
PLATE I

**BUZZARD SWAMP WATERFOWL AREA
NO. 6 DAM
VICINITY, FLOOD PLAIN & WATERSHED MAP**

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	8-10-81	DRAWING 80-556-B51 NUMBER 8-11-81
	8-10-81	APPROVED BY	JHP	



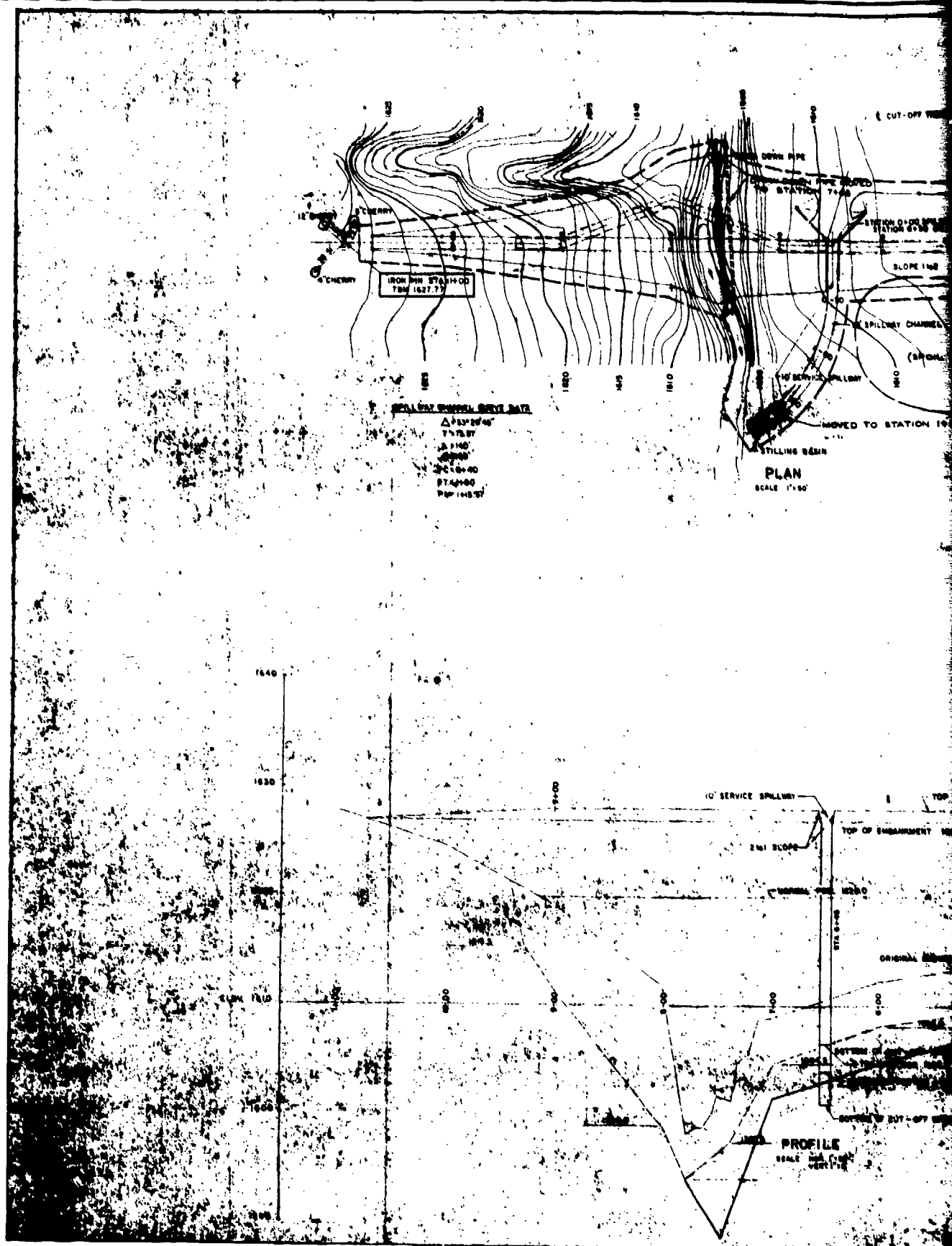


24-51-3			
FIELD NUMBER			
REMOVED TO THE OFFICE OF THE WATER & POWER ENGINEER BOARD - DEPARTMENT OF FORESTS & WILDLIFE - HALL OF WISDOM - 100			
PENNSYLVANIA GAME COMMISSION			
BUZZARD SWAMP WATERFOWL AREA			
PROJECT 2-5-69 FOREST & ELK COUNTIES PENNSYLVANIA			
RESERVOIR AREA			
IMPONDMENT 6			
L. ROBERT KIMBALL			
CONSULTING ENGINEER			
PITTSBURGH		PITTSBURGH	
DESIGNED BY	DATE	CHECKED BY	DATE
DESIGNED BY	DATE	CHECKED BY	DATE
APPROVED BY	DATE	CHECKED BY	DATE
DATE	CHECKED BY	DATE	CHECKED BY
3		17	

PLATE 2

D'APPOLONIA

DRAWN BY
8-10-81
CHECKED BY
8-10-81
APPROVED BY
8-11-81
DRAWING 80-556-B52



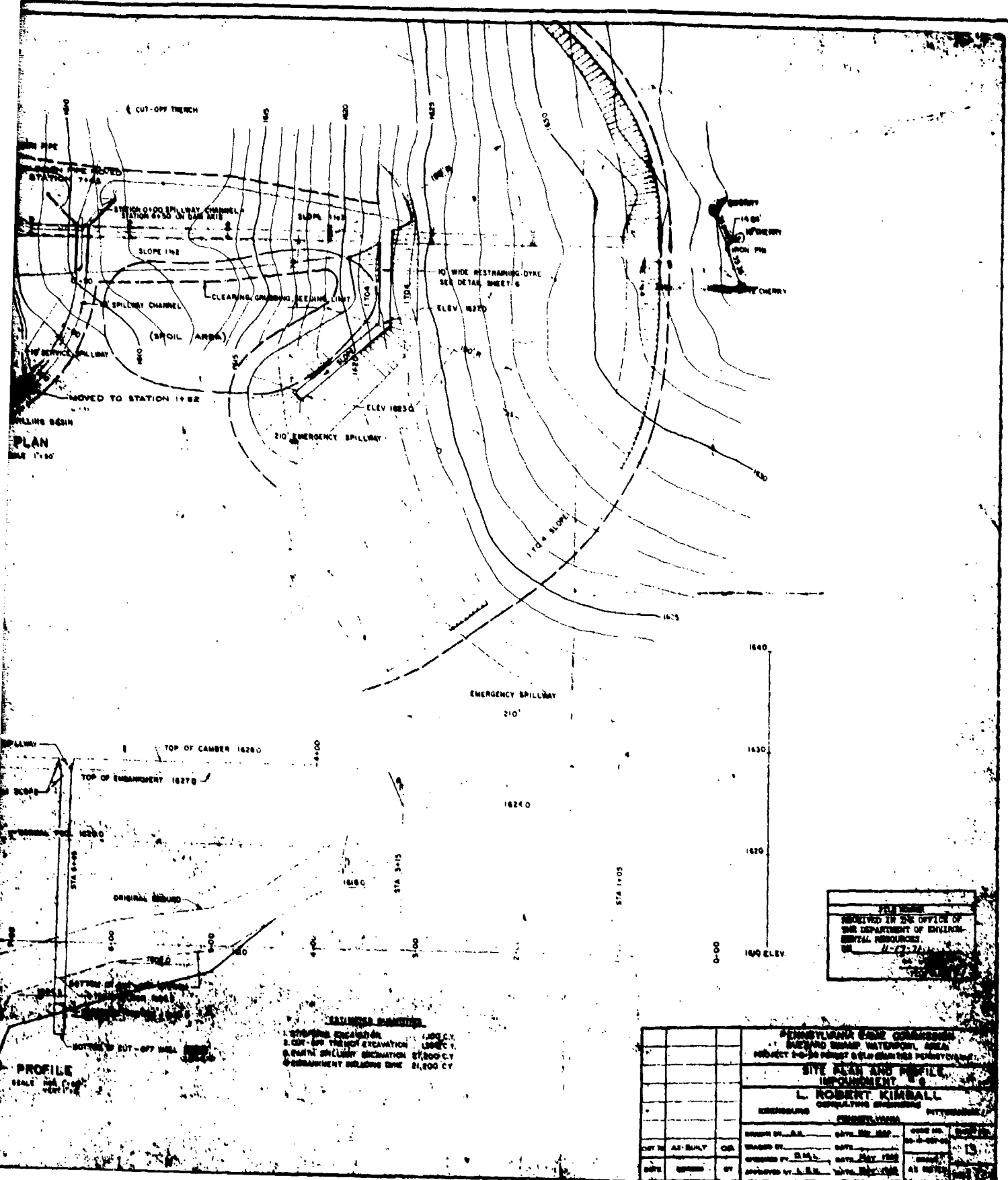


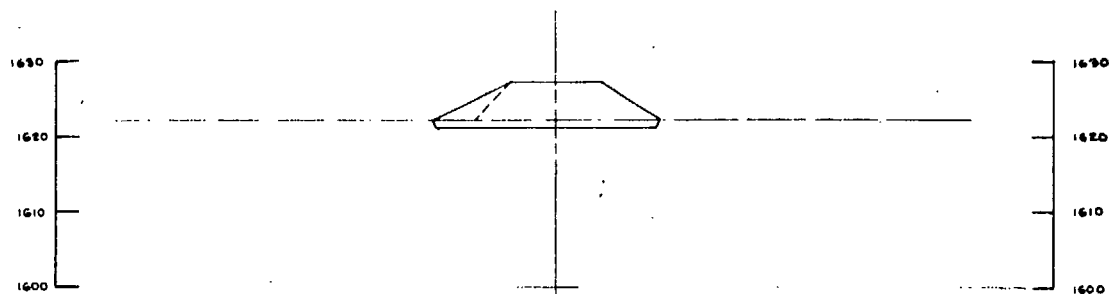
PLATE 3

D'APPOLONIA

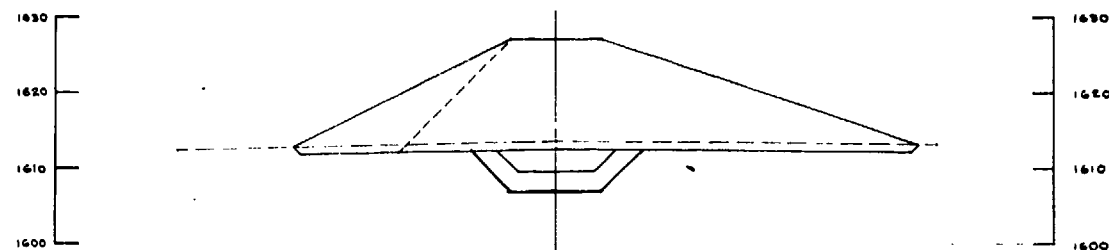
DRAWING 80-556-B53
 8-10-81 NUMBER 81

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 8-10-81
 CHECKED BY
 APPROVED BY

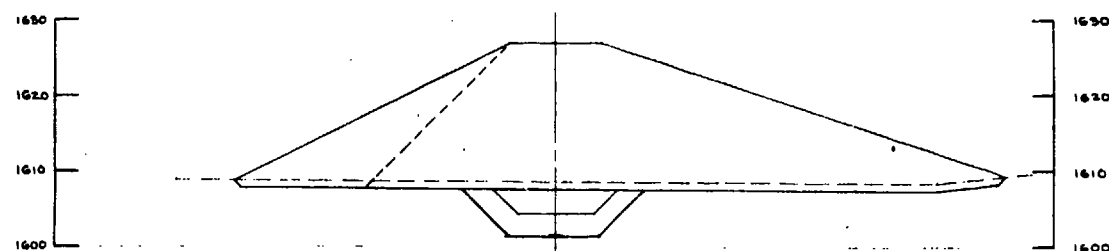
DRAWN
 BY



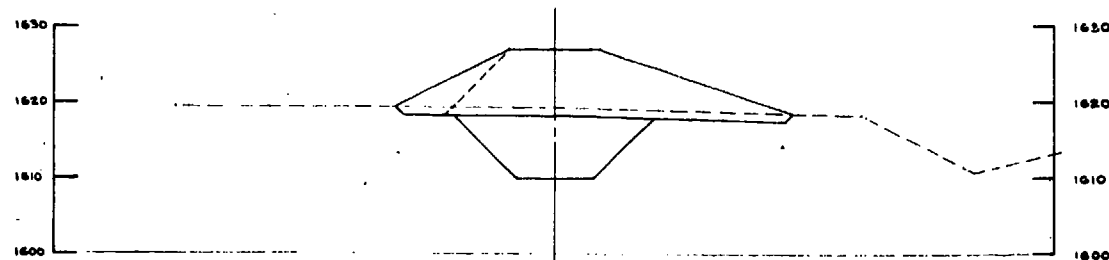
STATION 3+50



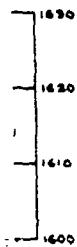
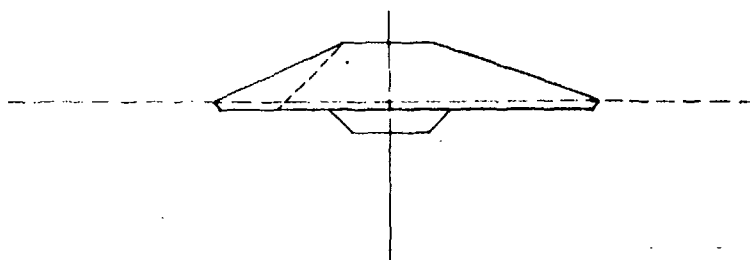
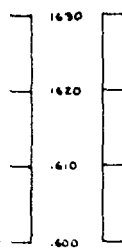
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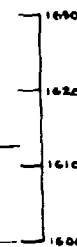
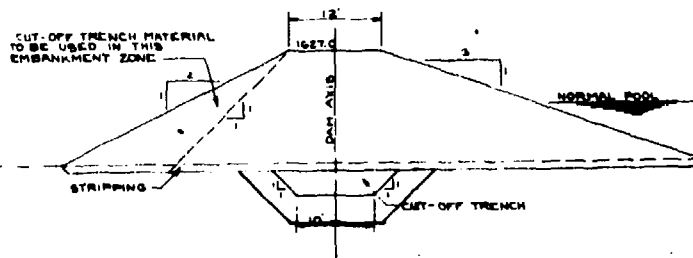
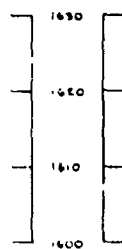
STATION 7+00



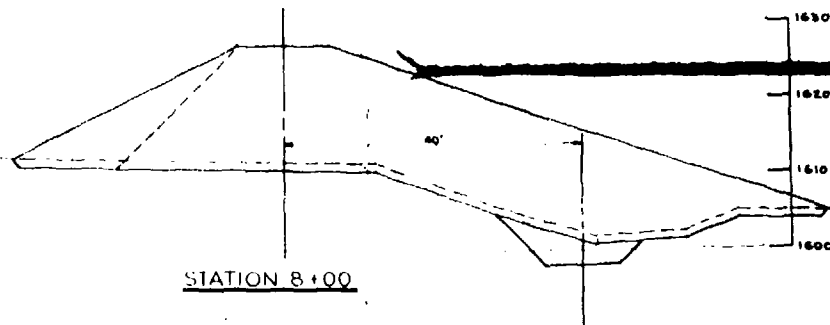
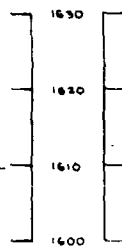
STATION 9+00



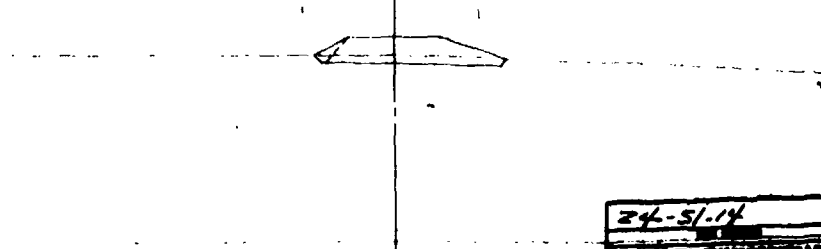
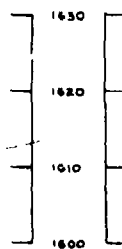
STATION 4+00



STATION 6+00
TYPICAL



STATION 8+00



STATION 10+00

NOTES:
1. CARRIER NOT SHOWN ON CROSS SECTIONS
2. SEE PROFILE FOR CUT-OFF TRENCH ELEVATIONS
3. STOPBAIL AND DEEP ENTRY EMBANKMENT

24-51-14
REVISION NO. 1
DATE 10-1-54
BY J. H. H. AS
10-1-54

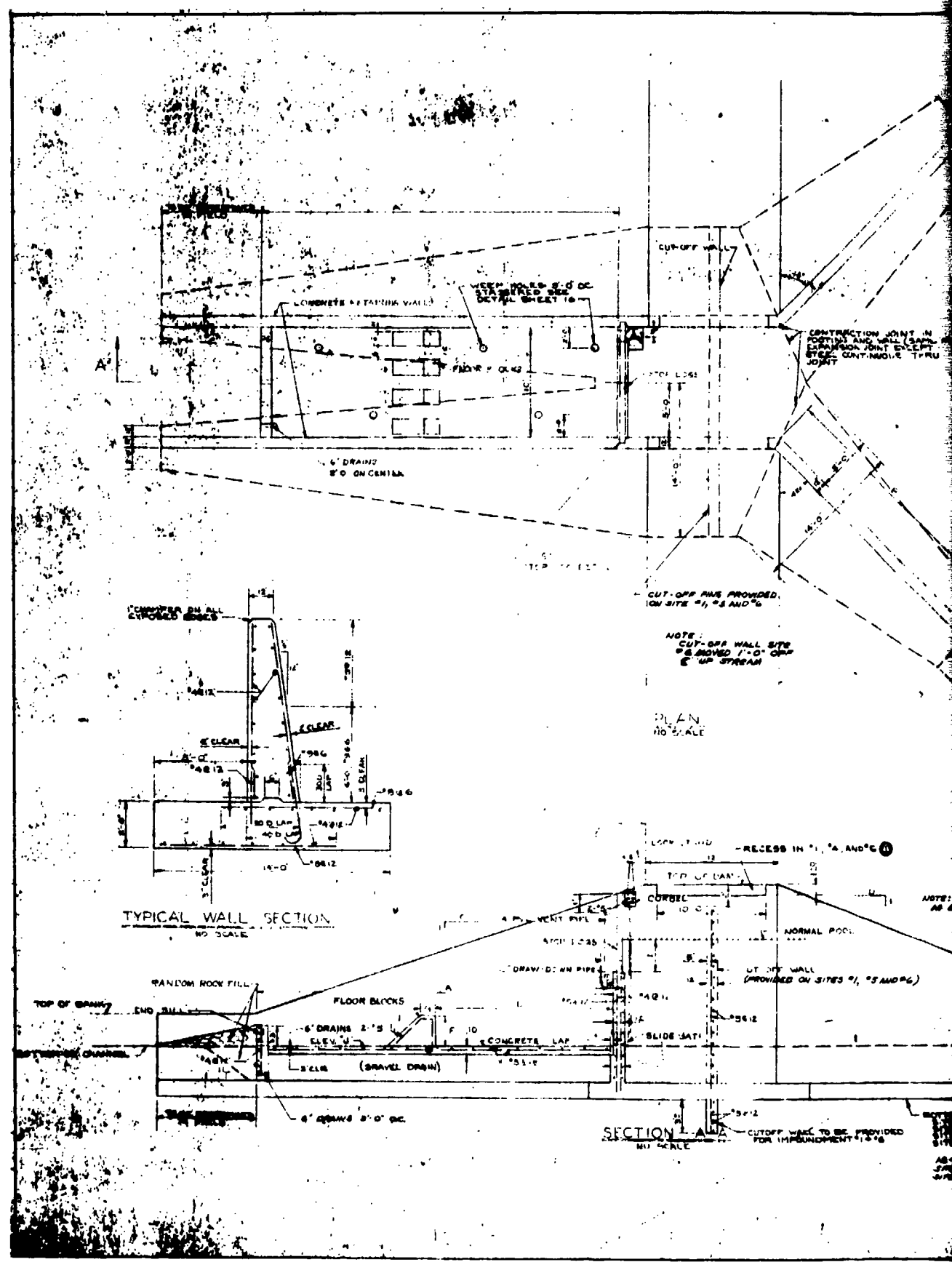
PENNSYLVANIA GAME COMMISSION			
BUZZARD SHUMP WINTERPORT AREA			
TYPICAL CROSS SECTIONS			
SECTION	DATE	BY	CHKD
1	10-1-54	J. H. H.	J. H. H.
2			
3			
4			
5			
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PLATE 4

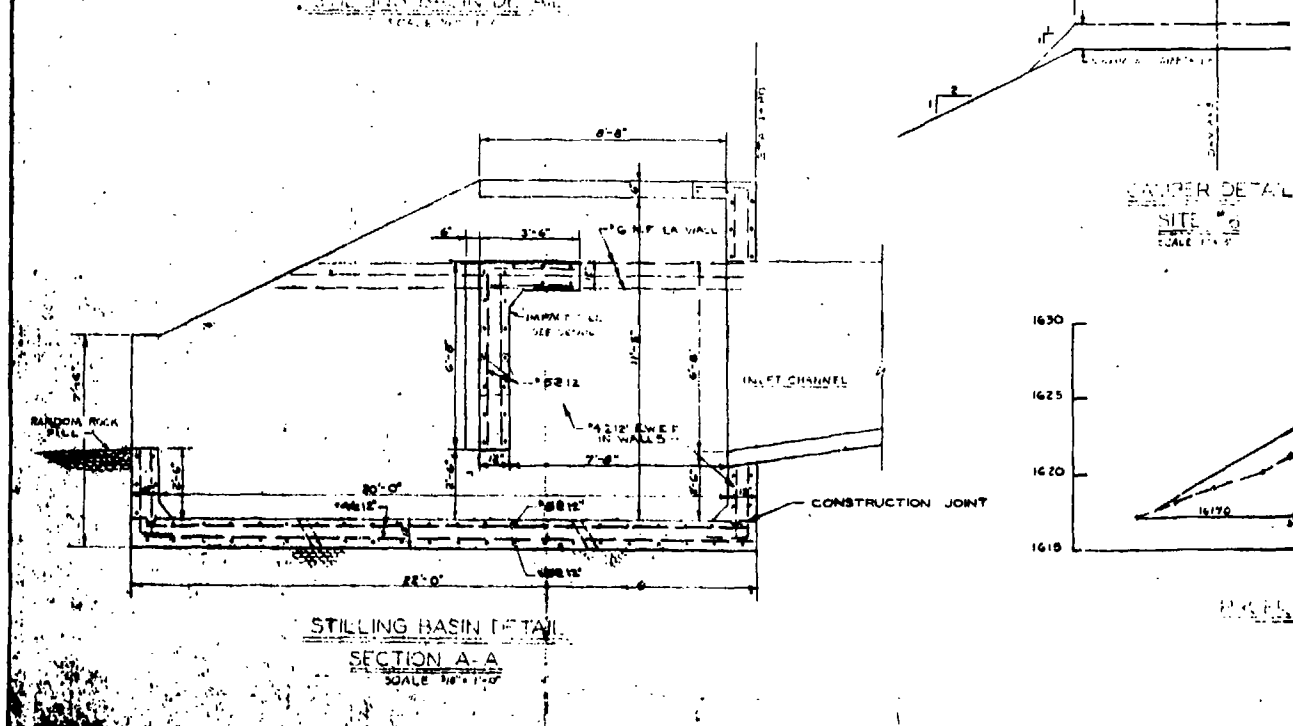
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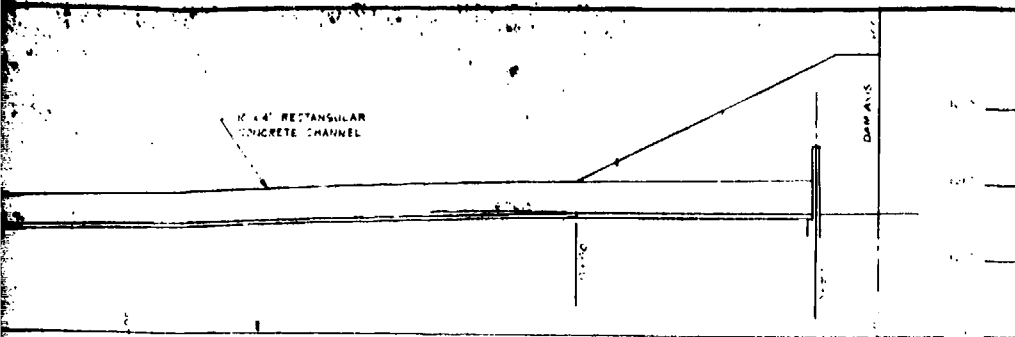
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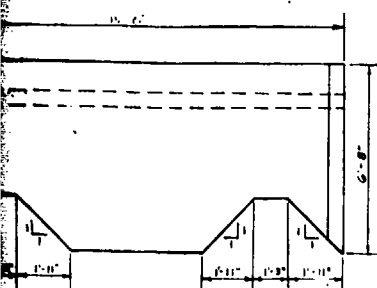


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	8-10-81

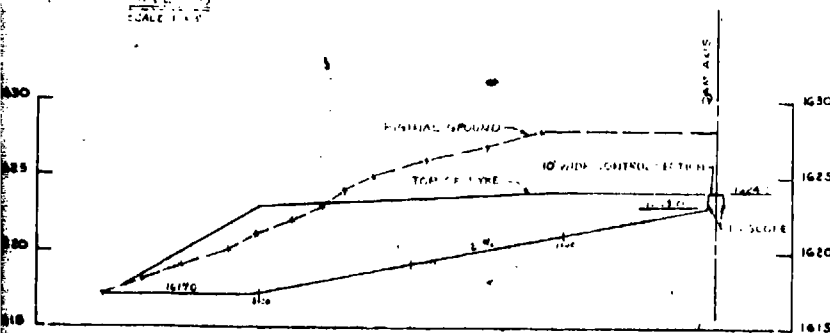
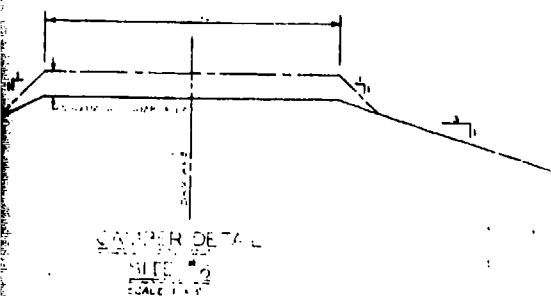




12' x 4' RECTANGULAR CONCRETE CHANNEL
SCALE 1" = 10'

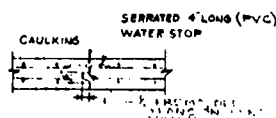


CROSS SECTION DETAIL
SCALE 1" = 10'

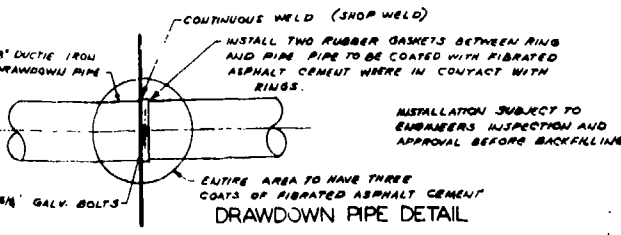
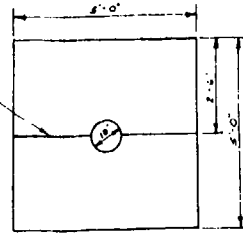
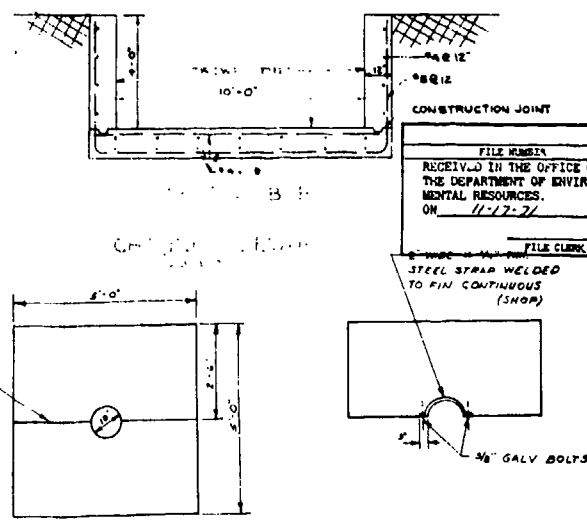
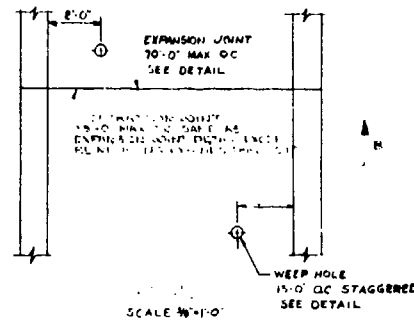


PROPOSED ALUMINUM ENERGY SPILLWAY

DATE: MAY 1980
1" = 5' VERT



CONTINUOUS WELD BOTH SIDES
OF PLATE (FIELD WELD)

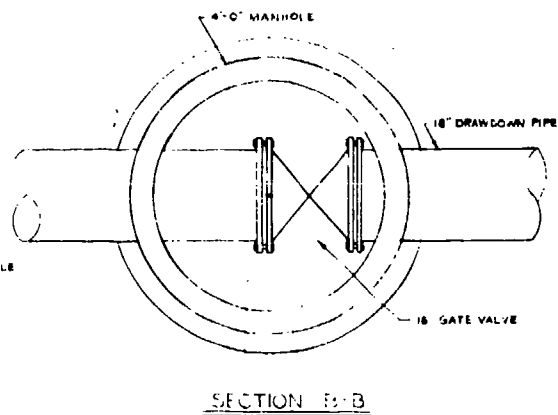
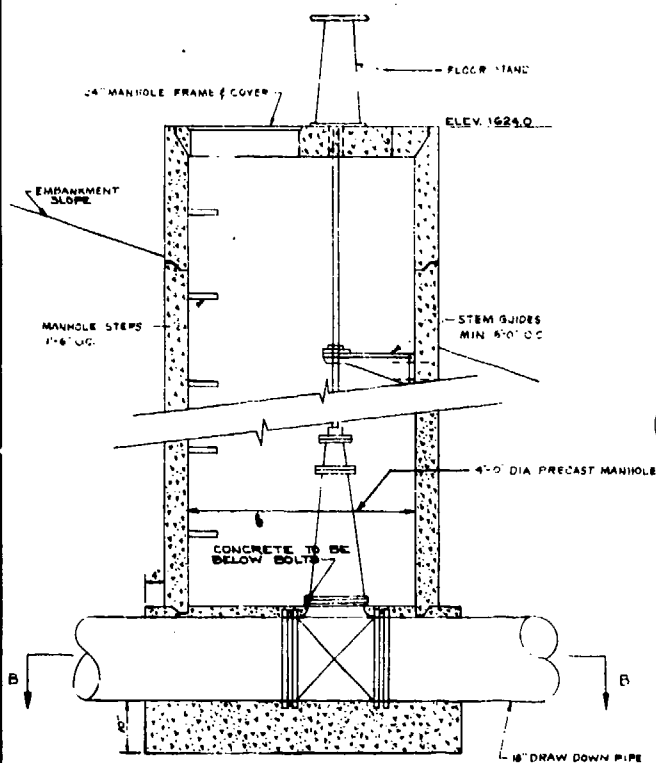
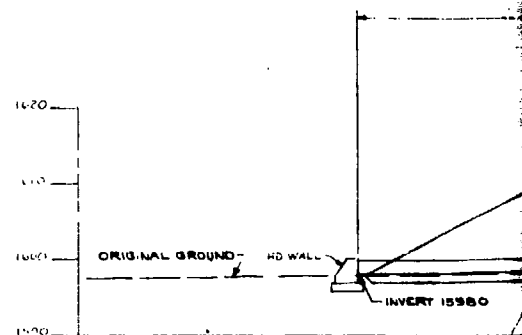
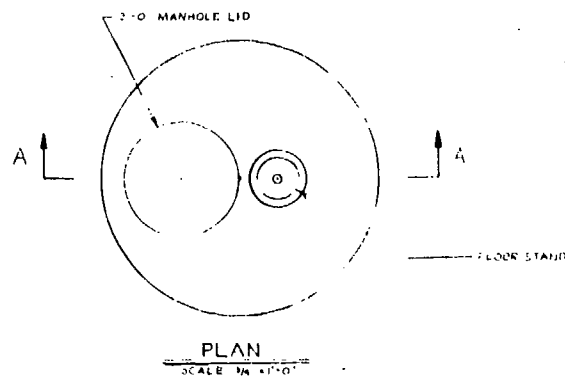


PENNSYLVANIA GAME COMMISSION BUZZARD SWAMP WATERFOWL AREA PROJECT 2-6-69 FOREST BELK COUNTIES PENNSYLVANIA			
SITE #6 DETAIL			
L. ROBERT KIMBALL CONSULTING ENGINEERS EBensburg, PENNSYLVANIA PITTSBURGH			
DRAWN BY: B.B.	DATE: MAY 1980	CHECK NO. 16	SHEET NO. 16
TRACED BY: B.B.	DATE: MAY 1980	SCALE: AS SHOWN	OF 17
CHECKED BY: P.M.L.	DATE: MAY 1980		
APPROVED BY: J.L.H.	DATE: MAY 1980		

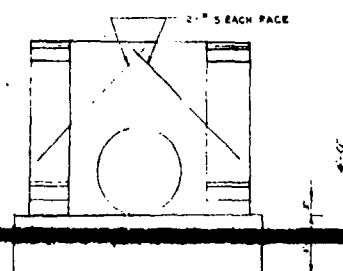
PLATE 6

D'APPOLONIA

DRAWN BY
 ACS
 8-10-81
 CHECKED BY
 JSE
 8-10-81
 APPROVED BY
 JBD
 8-10-81
 DRAWING NUMBER
 80-556-B56

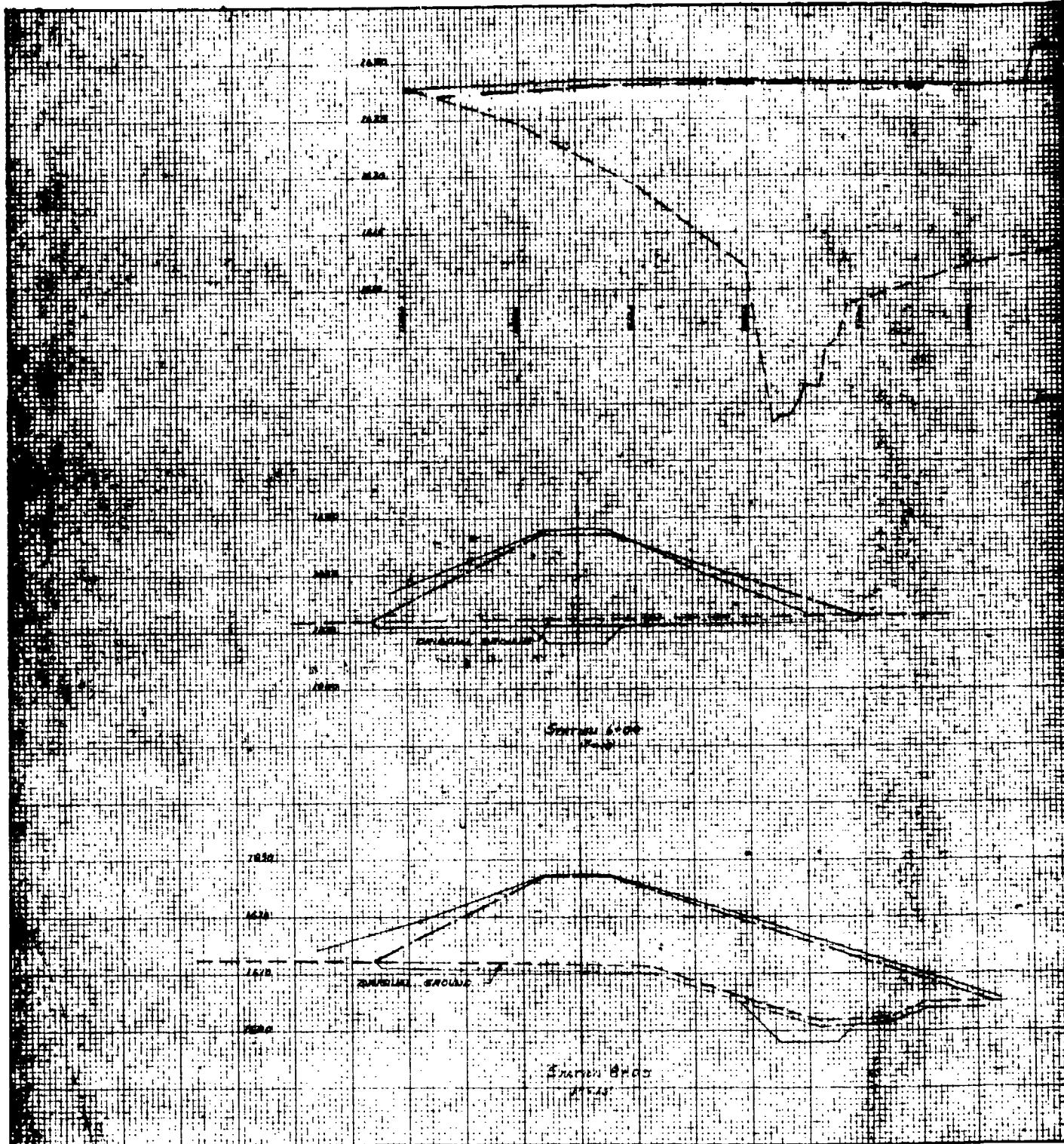


ACCESS PIT
 SCALE: 1/4" = 1'-0"



D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	8-10-81	DRAWING NUMBER	80-556-B57
	8-10-81	APPROVED BY	100		



DRAWING NUMBER 80-556-A44

8-10-81

8-10-81

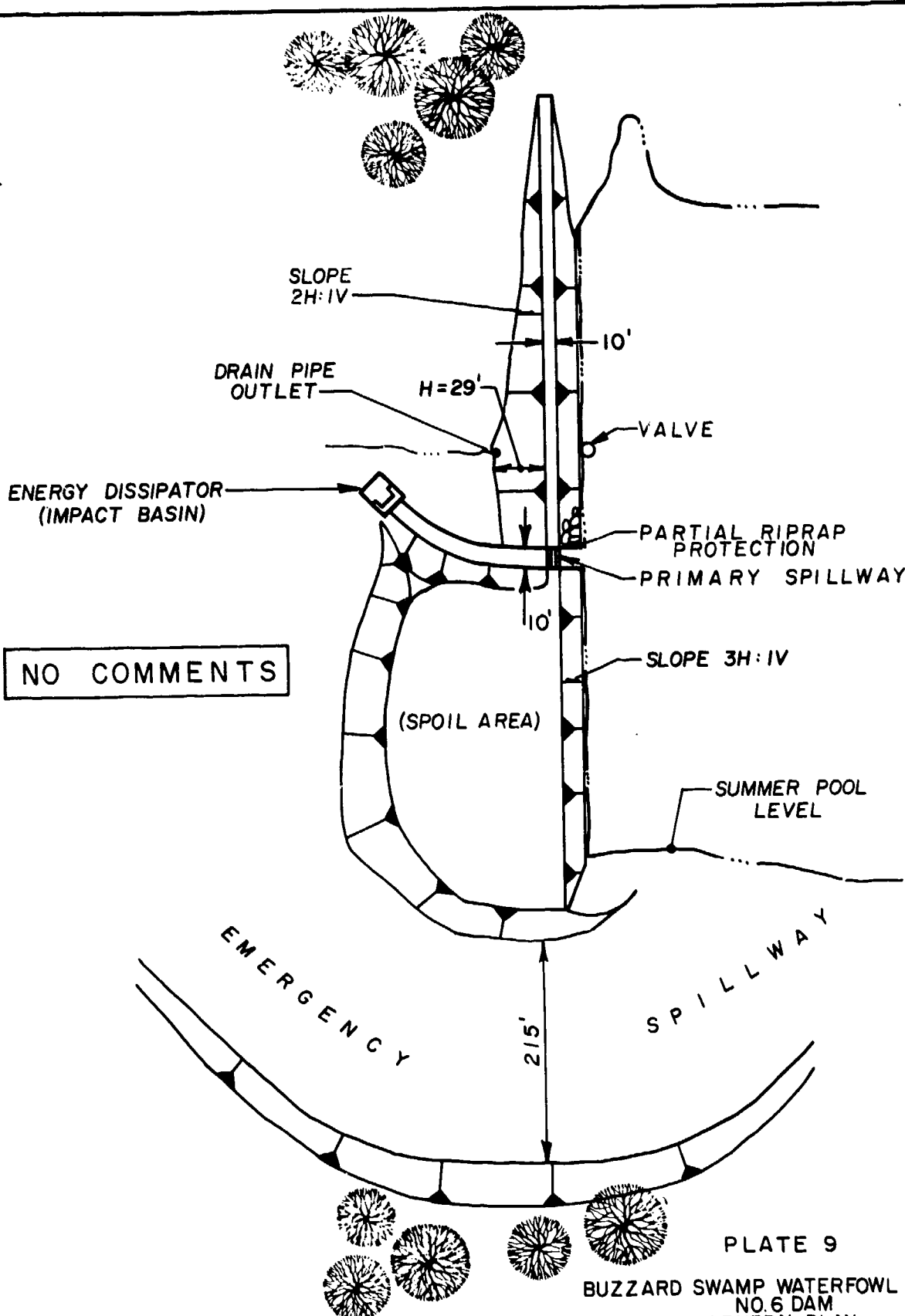
CHECKED BY JHP

APPROVED BY

SH

8-10-81

DRAWN BY



NO COMMENTS

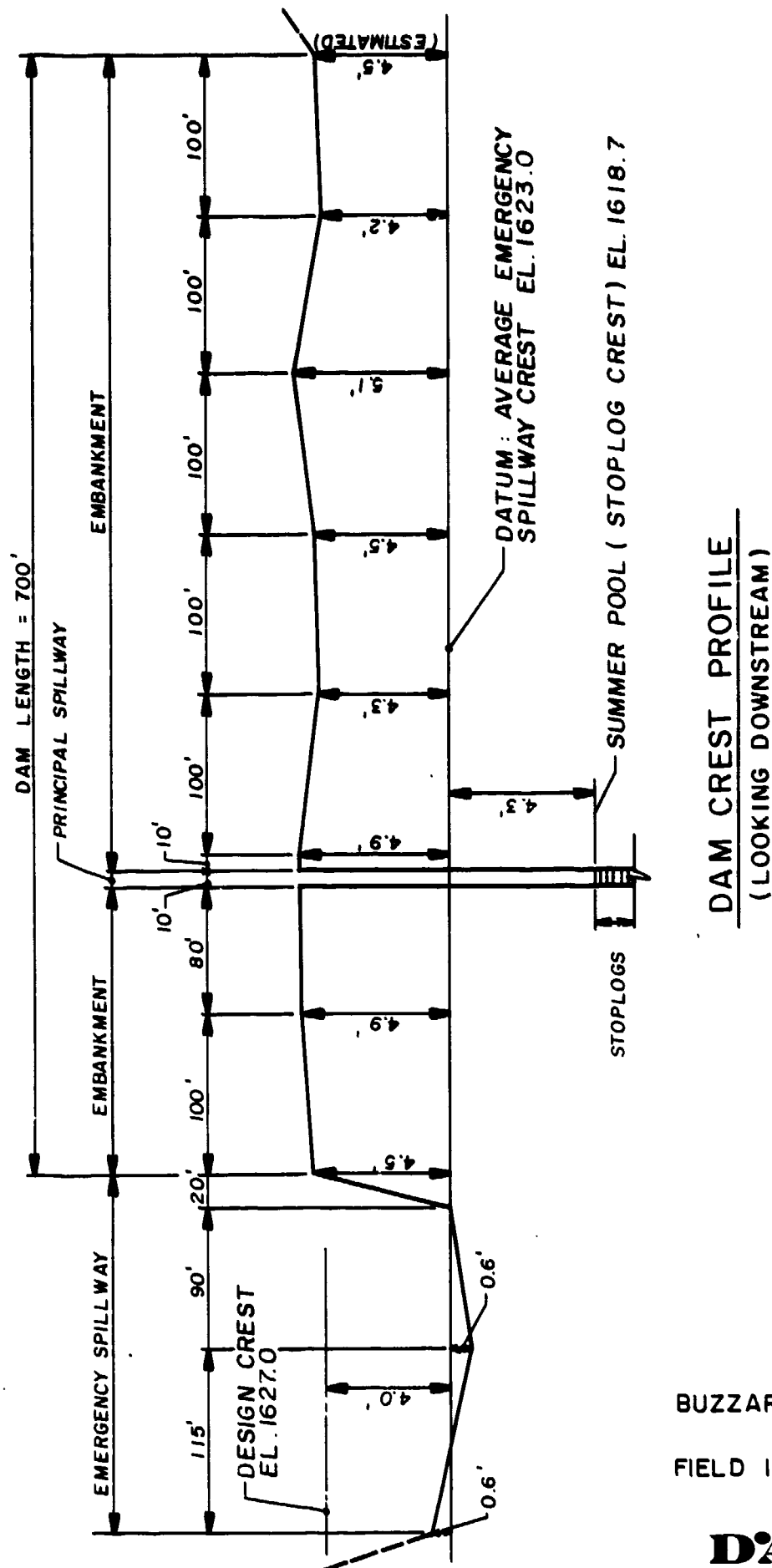
NOTE:
POOL LEVEL AT DATE OF INSPECTION
AT PRIMARY SPILLWAY CREST.

PLATE 9
BUZZARD SWAMP WATERFOWL AREA
NO. 6 DAM
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: JULY 17, 1981

D'APPOLONIA

"NOT TO SCALE"

DRAWN BY	ACS	CHECKED BY	8-10-81	DRAWING NUMBER	80-556-A45
	8-D-81	APPROVED BY	8-12-81		



DAM CREST PROFILE
(LOOKING DOWNSTREAM)

NOTES:

1. DAM CREST WAS SURVEYED RELATIVE TO SPILLWAY CREST.
2. DATUM ELEVATION AS PER DESIGN DRAWINGS.

PLATE 10

BUZZARD SWAMP WATERFOWL AREA
No. 6 DAM
DAM CREST SURVEY
FIELD INSPECTION DATE: JULY 17, 1981

D'APPOLONIA

APPENDIX F
REGIONAL GEOLOGY

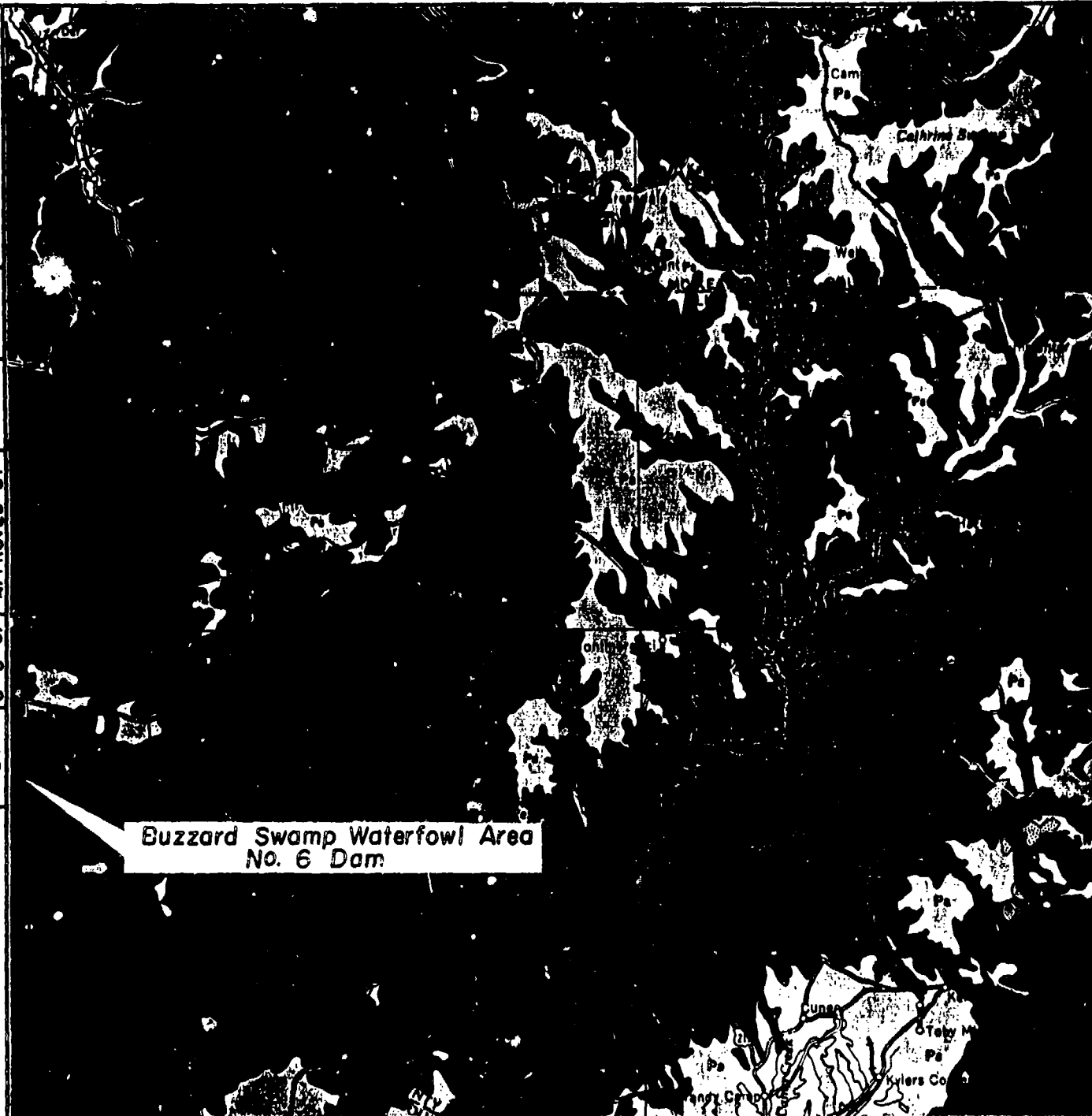
REGIONAL GEOLOGY
BUZZARD SWAMP WATERFOWL AREA NO. 6 DAM

The Buzzard Swamp Waterfowl Area No. 6 Dam is located in the Kanawha section of the Appalachian Plateaus physiographic province, an area characterized as a maturely dissected plateau of moderate to strong relief.

Bedrock immediately underlying the dam site is made up of Pennsylvanian Age strata commonly assigned to the Pottsville Group. This unit consists predominantly of conglomerates and sandstones, with minor amounts of shale and coal.

Rock strata in this area commonly exhibit low, open folds and can be considered horizontal for purposes of this report. Although no faulting is known to occur in the area, fractures in the form of jointing are common.

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Buzzard Swamp Waterfowl Area
No. 6 Dam



REFERENCE:
GEOLOGIC MAP OF PENNSYLVANIA PREPARED
BY COMMONWEALTH OF PENNA., DEPARTMENT OF
ENVIRONMENTAL RESOURCES, DATED: 1960
SCALE 1:250,000

GEOLOGY MAP

D'APPOLONIA

DRAWING 80-556-A4
NUMBER

2-17-81

2-17-81

AC

CHECKED BY

AC

APPROVED BY

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1-2-81

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PENNSYLVANIAN APPALACHIAN PLATEAU



Allegheny Group

Cyclic sequences of sandstone, shale, limestone and coal; numerous commercial coals; limestone thicken westward; Vanport Limestone in lower part of section; includes Freeport, Kittanning, and Clarion Formations.



Pottsville Group

Predominantly sandstones and conglomerates with thin shales and coals; some coals mineable locally.

ANTHRACITE REGION



Post-Pottsville Formations

Brown or gray sandstones and shales with some conglomerate and numerous mineable coals.



Pottsville Group

Light gray to white, coarse grained sandstones and conglomerates with some mineable coal; includes Sharp Mountain, Schuylkill, and Tumbling Run Formations.

MISSISSIPPIAN



Mauch Chunk Formation

Red shales with brown to greenish gray flaggy sandstones; includes Greenbrier Limestone in Fayette, Westmoreland, and Somerset counties; Loyalhanna Limestone at the base in northwestern Pennsylvania.



Pocono Group

Predominantly gray, hard, massive, cross-bedded conglomerate and sandstone with minor shale; includes in the Appalachian Plateau: Huron, Shinarump, Cincinnatus, Chemung, Conemaugh, and Knappe Formations; includes part of "Onondaga" of M. L. Fuller in Potter and Tioga counties.



Conemaugh Formation

Cyclic sequences of red and gray shales and sandstones with thin limestones and coals; massive Mahoning Sandstone commonly present at base; Ames Limestone present in middle of section; Brush Creek Limestone in lower part of section.

DEVONIAN UPPER

CENTRAL AND EASTERN PENNSYLVANIA



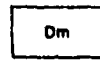
Osgway Formation

Brownish and greenish gray, fine and medium grained sandstones with some shales and scattered calcareous lenses; includes red shales which become more numerous eastward. Relation to type Osgway not proved.



Catakill Formation

Chiefly red to brownish shales and sandstones; includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.



Marine beds

Gray to olive brown shales, graywackes, and sandstones; contains "Chemung" beds and "Portage" beds including Burkholder, Brallier, Harrell, and Trimmers Rock; Tully Limestone at base.



Susquehanna Group

Barbed line to "Chemung-Catakill" contact of Second Pennsylvania Survey; County reports: barbs on "Chemung" side of line.

GEOLOGY MAP LEGEND

REFERENCE:

GEOLOGIC MAP OF PENNSYLVANIA PREPARED
BY COMMONWEALTH OF PENNA., DEPARTMENT OF
ENVIRONMENTAL RESOURCES, DATED: 1960
SCALE 1:250,000

D'APPOLONIA